AIR CONDITIONING HEATING AND VENTILATING

JULY 1960

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT

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Full Contents on Page 3

To help preserve the architectural qualities of this bank, especially its beautiful ceiling, supply and return grilles are located on either side of the clock, high on the rear wall. Seven Typhoon packages cool the entire building. Installation story page 101.

ASME PRESSURE RELIEF VALVES

Full selection of high capacity valves provides low cost protection

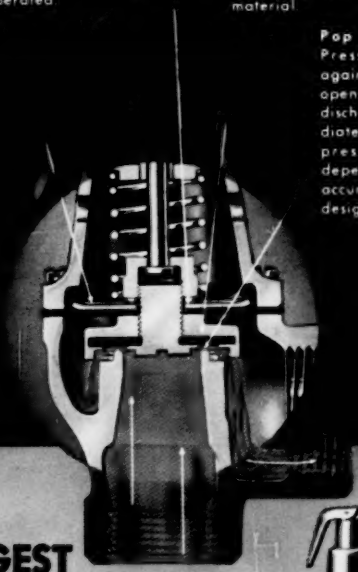
Watts No. 740 Series are especially designed for hot water space heating boilers. They have extremely high discharge capacities because of their large internal flow areas — making them the ideal, economical choice for boilers which previously required larger size valves for adequate protection. The ¾" size, for example, rated at 895,000 BTU HR at 30 lbs., approximates and in some cases exceeds the ratings of many 1" valves. This wide range of relieving capacities provides a much lower BTU per thousand cost, lets you size a single valve over a variety of boilers, and simplifies your stocking problems. Pressure range from 30 to 75 lbs.

Water Seal — Provides precise alignment of sent to disc and eliminates need of hazardous mechanical guides which can stick or freeze a valve shut from lime or corrosion. Seal also protects spring working parts from water or steam during relief.

Double-Safe Design — No mechanical guides — not diaphragm operated.

Stickage-free — Disc-to-Metal-Seating — Heat resisting, stickage proof silicone disc material.

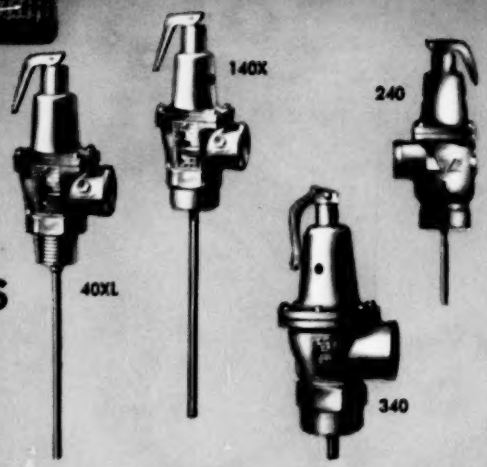
Pop Action Operation — Pressure exerted directly against disc pops valve wide open for steam relief. Full discharge rate reached immediately at the set opening pressure, and does not depend on further pressure accumulation as in some other designs.



Be sure . . . Use

Protection and Control Specialties

BIGGEST CHOICE IN ASME RATED T & P RELIEF VALVES FOR HOT WATER SUPPLY SYSTEMS



Watts No. 40-140-240-340 Series automatic reseating temperature and pressure relief valves are pressure steam rated by ASME and are available in sizes ¾" to 2" inclusive. The 40-140-240 Series are listed by AGA, having been tested and rated under the new American Standard ASA Z21.22-1958. Their construction includes the same pop type action seat and disc found in the No. 740 Series. Result: You get both ASME steam rated pressure relief and AGA steam rated temperature relief *in a single valve* — the *most complete protection* for hot water supply systems.

Where separate installation of safety devices is preferred, use Watts No. 174A Series ASME pressure-only relief valves in sizes ¾" to 2". Pressure range 75 lbs. to 160 lbs.

Watts Regulator Company, Lawrence, Massachusetts

Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8467 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

80157

ARMSTRONG STEAM TRAPS

How Different Condensing Rates Can Slow Production

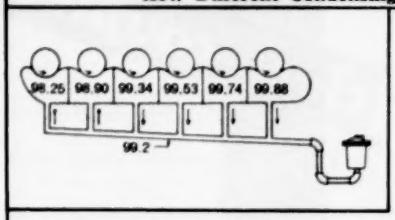


Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

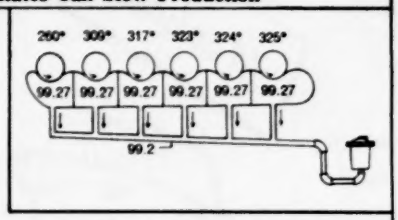


Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

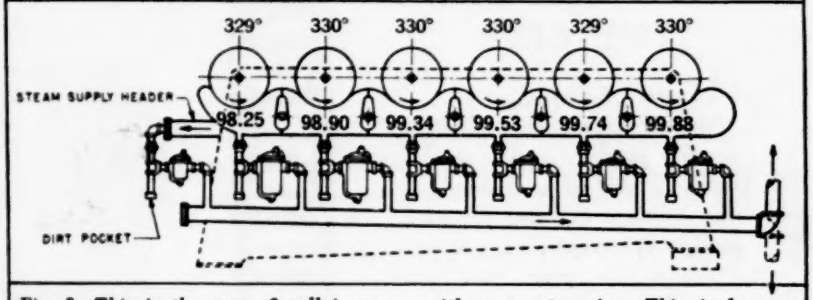


Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

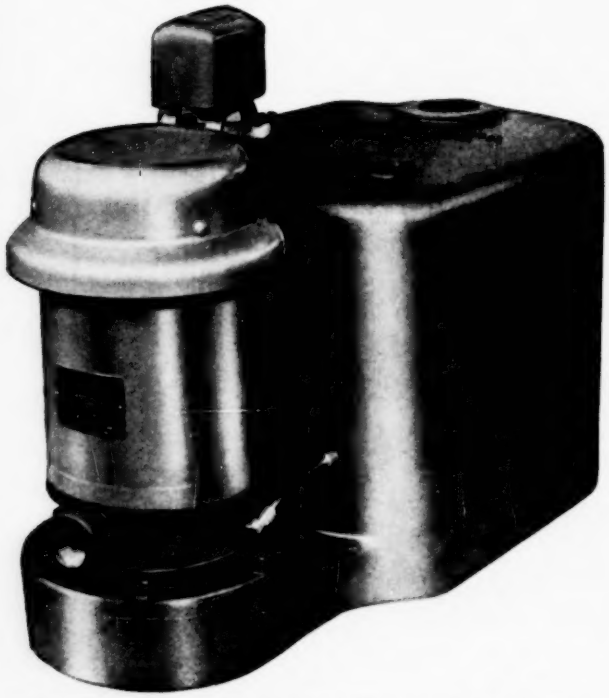
Mechanical Shaft-S

cl coupled design

Specify SKIDMORE

More Capacity!

More Performance!



SKIDMORE VERTICAL "CCVS" PUMP

RIGHT DOWN THE LINE . . .

Whatever the application . . . wherever you need a dependable heating pump . . . one thing is sure . . . Skidmore advanced design engineering has produced pumps of simple, rugged construction to give you year around, economical, maintenance-free service. See your Skidmore Representative today for complete information.

Skidmore Pumps have set a standard of performance and dependability—through continual research and development since 1921

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COR RATION
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AIR CONDITIONING HEATING AND VENTILATING

Volume 57, Number 7 **July, 1960**

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COVER PHOTO: Plans for a central cooling system for Bronx River Savings Bank, whose main area is shown on the cover, were scrapped in favor of an installation of seven packages, supplying the flexibility required by the several diverse functions performed in the three-story building. See **Applications and Installations,** page 101.

In the same department, see also how simply and logically the air conditioning system for 66 Beaver Street, an office building in New York's financial district, was laid out. Walls and floor comprise half of the horizontal air distribution in this space- and materials-saving installation. See page 98.

An improved method of air conditioning computer rooms is also described in Applications and Installations this month. It avoids the inevitable cold drafts that result from excessive cool air supply when computers take and discharge room air. See page 100.

HIGH SPOTS in this issue

ELECTRIC HEAT: Whether it is discussed in a positive or negative sense, electric heat is at least discussed at almost every meeting or conference related to any way to space heating. Such a timely topic is deserving of the twelve pages we are devoting to it in this month's **Reference Section.** Beginning on page 77 you'll find design and application data for residential, commercial, industrial and institutional **electric space heating.**

WATER SYSTEMS: We like the theme, "Today's operating problems aid tomorrow's design", and feel that its applications are many. Case in point this month is **use and abuse of mechanical shaft seals** on pumps in both heating and cooling systems. Author, Dr. Sidney Sussman, presents some sound thinking on the subject in the lead article, beginning on page 61.

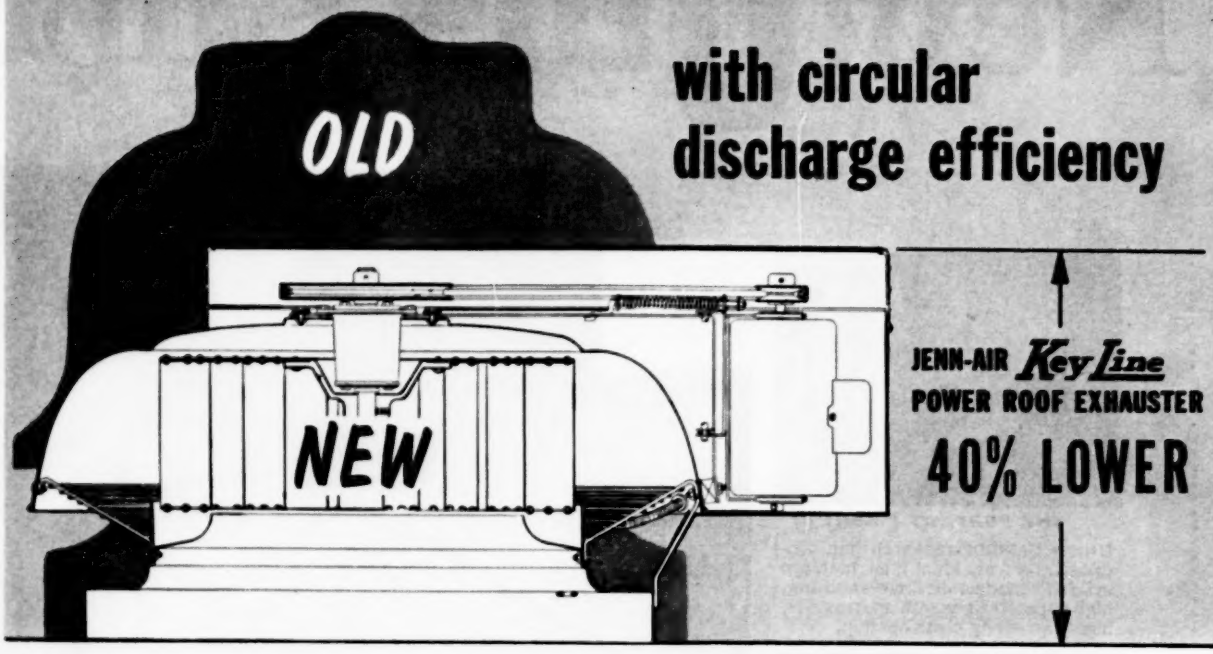
AIR CONDITIONING: An economic evaluation of various **methods for rejecting the heat removed from air conditioning systems** is presented in an article by M. J. Wilson. Containing a wealth of tabular data, this story starts on page 70.

HOSPITALS: Can you safely select **electronic temperature controls for surgical suites?** A position on this controversial question has been taken by a medical doctor specializing in anesthesiology. A man with a good deal of experience in this subject, he presents the reasons for his position in an article beginning on page 67.

STANDARD ATMOSPHERE: Everybody talks about standard temperature and pressure, and most engineers easily handle conversions at sea level conditions. The math and physics behind the so-called **U. S. Standard Atmosphere at other elevations,** however, are of less familiar but equally important engineering significance. Page 93.

LOWEST CONTOUR OF ANY UNIT

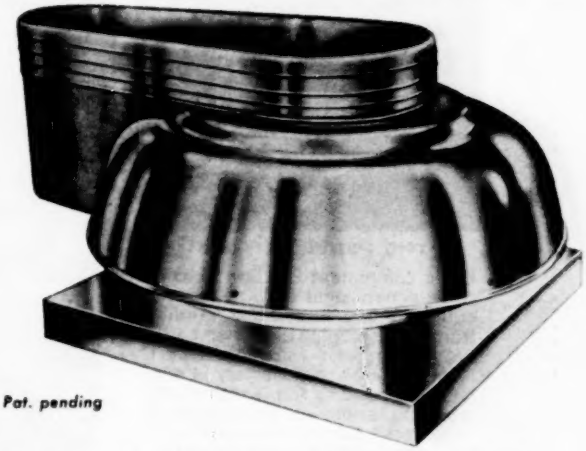
with circular discharge efficiency



...and motor and drive are out of air stream!

Check these other KEY features:

- **Maintenance-free spun aluminum housing**
- **Ten-year-lubricated ball bearing motor mounted out of air stream**
- **Drive with permanently sealed and lubricated ball bearings**
- **Heavy cast iron pulleys, adjustable to permit speed variation**
- **Belts with long drive centers for extra-long wear**
- **Automatic belt tightening device to assure constant fan speed . . . no service call-backs for adjustment**
- **Built-in bird guard**
- **Hinged curb for damper access (optional)**



Pat. pending

The Jenn-Air KEY LINE meets the most critical standards for styling, quiet operation and air moving efficiency . . . it's the key to better ventilation in any roof installation. Centrifugal or axial models. Capacities from 725 to 27,000 cfm. Write for Bulletins 60-CK (centrifugal) and 60-AK (axial).

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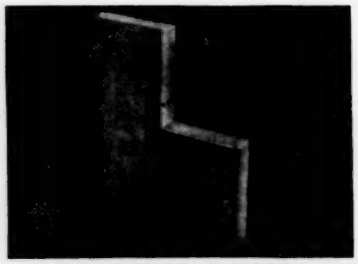
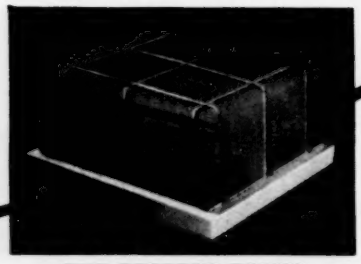
THE STARTLING FACTS ON THE

New ULOK Cube BRAND



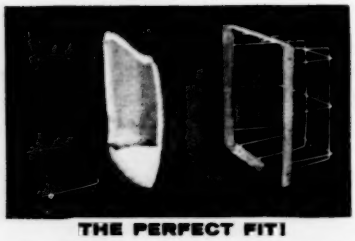
THE PERFECT FIBER!

UNION CARBIDE research has produced the truly ideal filter medium in DYNEL modacrylic fiber—a strong, high capacity fiber with an irregular, highly arresting cross section.



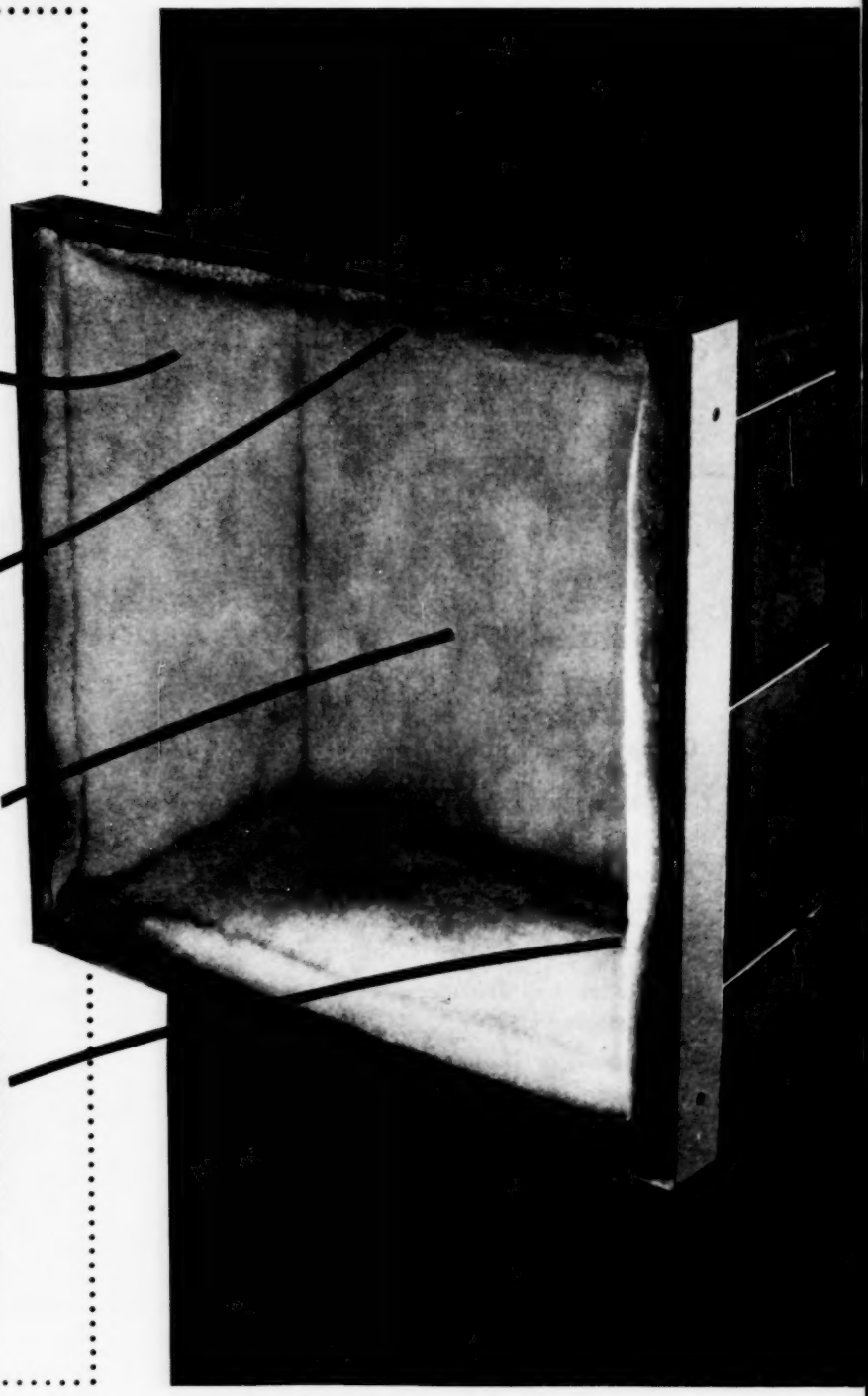
THE PERFECT FORM!

Basic component is a low density, three-dimensional batt, sewed into cube shape. Rust-proof retainer frame is inserted in batt, then batt is inserted in wire retaining basket. Final three-piece assembly is supported by holding frame within unit, is easy to handle—no sharp edges or "splinters". Easy to dispose of when full—simply collapse and discard . . . the dust is in the bag!



THE PERFECT FIT!

Shape of retainer frame inside batt permits filter to seal itself in holding frame. Final filter assembly is a tight, leak-proof, press fit.



Type Air Filter:

New Filter Medium!

DYNEL filter medium stops and holds unusually large quantities of dirt. Self-sealing, leak-proof assembly completely eliminates problem of filter bypass . . . provides maximum economy at highly acceptable filtration levels.

Saves Change-Over Dollars!

ULOK Cube Filter lasts 6 times longer. Dirt is first trapped on inside face of filter. As dirt builds up, air flow is shunted to large filtering area of four sides. Thus, even after several *pounds* of dirt have been collected, high filtering efficiency and low pressure drop is maintained. This "reverse loading" process increases service life *6 times* over that of conventional filters. Think of the savings in maintenance!

Uses Half The Space!

Medium-size ULOK Cube Filter has a filtering surface of 1040 sq. in.—140 more than a conventional 30″ x 30″ flat filter—yet it presents a frontal area of only 20″ x 20″. Filter bank area can thus be reduced by *half* with medium-depth filter, *even more* with deeper models.

At All Velocities!

ULOK Cube Type Air Filters afford the high filtering efficiency characteristic of low velocity units even in units employing air volumes as high as 1970 cfm!

Proved In Operation!

ULOK Cube Type Air Filters have been soundly proved in numerous installations. Reflecting a complete range of the filtering problems presented under varying operating conditions, these field trials were complemented by extensive and extremely severe laboratory tests.

Ideal for all commercial and industrial air conditioning, heating, and ventilating systems, ULOK Cube Type Air Filters are available in 12 sizes to meet any requirement.

WRITE TODAY FOR FURTHER INFORMATION AND PRICES.

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UNION CARBIDE DEVELOPMENT COMPANY

Division of Union Carbide Corporation

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New CEC officers are, seated left to right, George J. Toman, secretary; Hueston M. Smith, president; Harold P. King, first vice-president; Frederick K. Steel, second vice-president. Standing, left to right, are Lester L. Bosch, treas., Ralph M. Westcott, immediate past president.

Manual of Practice

Issued by Consulting Engineers Council

Herein are highlights of CEC's Annual Meeting, reflecting increasing complexity and scope in the fight for better professional conditions.

COUNCIL delegates from 31 states and regional associations of consulting engineers attended the annual meeting of the Consulting Engineers Council Board of Directors held in Gearhart, Ore., May 4 to 7. The interesting agenda included discussions on the following topics: Professional liability insurance, accounting systems for consulting engineers, offices, opposition to public encroachment of private engineering, package deal and turnkey operators, legislation affecting consultants, public relations, registration, consultants' responsibilities in disasters, interprofessional practice and indexing systems for manufacturers' technical literature.

Recommended Contract Forms

Proceeding quickly with such internal matters as election of officers, and adoption of bylaws and budget, the Consulting Engineers Council Directors received, discussed, and approved four new C.E.C. engineer-architect, and principal engineer-associate engineer forms of contract. Already available to council members are recommended forms of contract for use in owner-engineer, and architect-engineer agreements. Presenting the new forms was Documents Committee Co-chairman, George W. Poulsen, Jr. of Salt Lake City, who reported that demand for previously published standardized forms of advertisement, information for bidders, proposal, agreement, bid bond, performance bond, labor and material payment bond, and general conditions of the contract, had gratifyingly necessitated a complete reprinting.

Lester L. Bosch, Cincinnati, presented the first draft of a proposed C.E.C. indexing system for manufacturers' catalogs and technical literature. It is the intention of the council to prepare a streamlined filing system which will eventually be available for use not only by C.E.C. members, but by manufacturers, too.

Public relations came in for its share of the limelight as just-published copies of "You and Public Relations," a guide to individual consulting firm public relations programs, were distributed. Pacific National

(Continued on page 10)

And in Denver — A FUTURE OF FAULTLESS SERVICE

Reflecting the phenomenal demand for prestige office space in rapidly expanding Denver, this recently completed 28 story COYNE & DELANY installation is the largest and tallest office building in the Rocky Mountain West. Erected at a cost of $10,000,000, the First National Bank Building offers the center of Denver's financial district a gleaming precast stone, aluminum, and glass exterior plus a roof designed as a heliport. Initiators of the project were the Murchison brothers of Dallas who, several years ago, constructed the Denver Club office building...another COYNE & DELANY installation...which has been unable to satisfy demand for space. For those who have lived with DELANY, there is no other flush valve. Leadership in design, unequalled nationwide service, eighty years of business integrity; all these factors spell DELANY— "the fastest growing name in flush valves!"

1ST NATIONAL BANK BUILDING
Denver, Colorado

RAYMOND HARRY ERVIN & ASSOCIATES
architects

MARSHALL & JOHNSON
mechanical engineers

MEAD & MOUNT CONSTRUCTION CO.
general contractor

NATKIN & COMPANY
plumbing contractor

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AMERICAN RADIATOR AND STANDARD SANITARY CORP.
plumbing fixtures manufacturer

DELANY . . . THE ONLY COMPLETELY DIAPHRAGM-OPERATED LINE OF NATIONALLY DISTRIBUTED FLUSH VALVES

All Delany Flush Valves give the quality of diaphragm operation that others only offer in their "premium" valves. Durable, longer-lasting chrome tanned leather diaphragms in Delany Flush Valves operate best in water service . . . provide "life-of-building" performance. Decide on Delany . . . Fastest Growing Flush Valve Line!

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IN CANADA: THE JAMES ROBERTSON CO. LTD.

DELANY *Flush* VALVES

SINCE 1879

(Continued from page 8)

Advertising Agency, Portland, Ore., was retained to expand the C.E.C. public relations program.

The professional liability insurance program was described as being "well off the ground" with an increasing number of members securing such coverage. Possible reductions in rates as a result of council members' outstanding experience record was reported by the insurance carrier.

Manual of Practice

Highlighting the meeting was the distribution of first copies of the long-awaited C.E.C. Manual of Practice for Consulting Engineers. The manual was designed to assemble, in one volume, the general mechanics and recommended principles of performance that should be used as a guide in the conduct of a successful consulting engineering practice. The manual is intended not only for practicing consultants, but for engineering students, manufacturers, and clients.

Prepared by a special Task Force Committee under the Chairmanship of Thomas R. Miles, Portland, the manual includes sections for the guidance of consulting engineers in relationships with clients, as well as a section on the evaluation of potential clients. Transmitting engineering information through drawings and specifications is also covered.

The nature and extent of consulting services are discussed, as is the criteria for engineering performance. Also covered in detail are the handling of bids, free engineering, kickbacks, moonlighters, and the problems of engineer-constructors.

Of particular importance is the section on organization and operation of a consulting practice. In this section, the manual discusses fees, employee relations, insurance, negotiation, and offers a most detailed accounting system for use in a consulting office. As explained by Committee Chairman Miles, ". . . the manual presents not only the basic information, but seeks to explain the philosophies involved in each case."

With approximately 1000 copies slated for distribution to the C.E.C. membership, the committee intends to utilize appropriate suggestions and still-in-the-works committee reports in adding to, and revising future editions.

Other Actions at Meeting

Recent recriminations of consultants by certain agencies of the Federal Government also came in for considerable attention. Outgoing President, Ralph M. Westcott, Los Angeles, reported that the council has established an emergency committee to challenge accusations that "use of consulting engineers costs more." According to Westcott (who, in April, reported the consultants' viewpoint to the Appropriations Subcommittee of the House Public Works Committee), the records show that engineering costs on projects utilizing only private firms are invariably lower than the design costs on similar projects handled by public engineering bodies.

Quick action was taken on a report by the Gulf Institute of Consulting Engineers to the effect that Civil Service personnel in Louisiana are pressuring registration officials for "easy" registration under a special legislative ruling. The directors adopted a resolution stating in part:

> "Any circumvention of proper qualifications of persons authorized to practice engineering will seriously endanger the public health, safety and welfare. . . . The potential dangers to the public health, safety and welfare should be clearly brought to the attention of all proper authorities, including public officials, legislators, and civic leaders. . . ."

Later, Harold P. King, the Council's vice-president, Sherman Oaks, Calif., told the Board that Landrum-Griffin Amendments—SB 2643 and HR 9070—(pending before Congress), if adopted, will permit a complete work stoppage at construction project sites for no other reason than the fact that employees of one of the sub-contractors are non-union. This was interpreted by the C.E.C. Board to include design sub-contractors, which could lead to attempts to force unionization on private engineering firms. Telegrams to local Congressmen were immediately dispatched by all present, and a condemning resolution authorized for submission to the proper authorities.

A consultant's role in times of disaster was defined through adoption of a resolution calling for an engineer to render services to the best of his ability, and to respond to requests for emergency assistance "whenever temperate public opinion expects such services. . . . when several engineers have been summoned in case of an emergency, the first to arrive shall be considered the engineer in charge."

Interesting reports were presented by a number of individual State Associations.

South Dakota Delegate, John H. Reese, described the activities of consulting engineers in his state in resolving an especially ticklish situation of "side line engineering" by college professors.

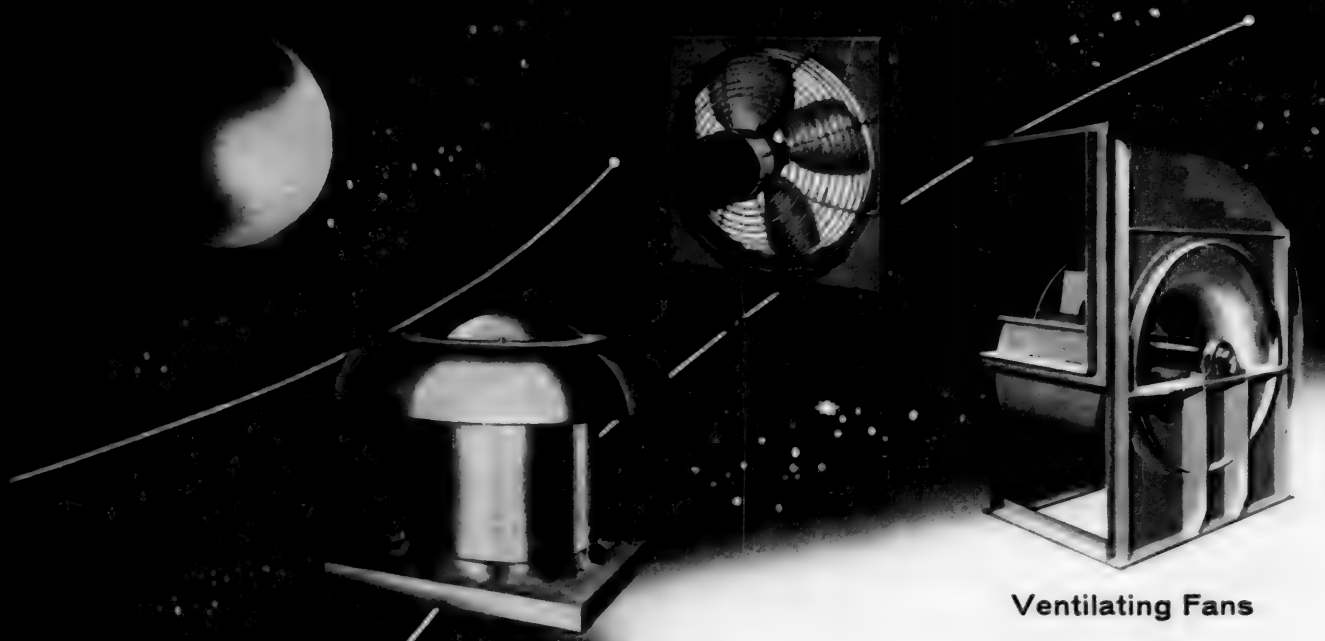
Horace Whitacre of Seattle, Wash., provided a complete report of his association's battle against corporate practice measures proposed by the Committee on Engineering Law. Council support of the Washington Association stand was extended by the Board.

Noted with satisfaction by all present was the fact that John F. Hennessy, Sr., C.E.C. representative to the EJC-AIA Joint Committee, is to become co-chairman of the Joint Committee for the coming year. Indications from Mr. Hennessy were that the EJC-AIA sub-committee on "Division of Responsibility" is ready to release a voluminous report for distribution to the Associations represented on the Committee.

William W. Moore, of the consulting firm of Dames and Moore, Los Angeles, was named to accompany Edward J. Wolff, Chicago, as Alternate Representative to the 1960 meeting of the International Federation of Consulting Engineers. C.E.C. is United States member of this organization.

Site of the next (semi-annual) meeting of the Consulting Engineers Council will be Pittsburgh, Pennsylvania. Date will be November 10, 1960.

(News of the Month follows on page 12)



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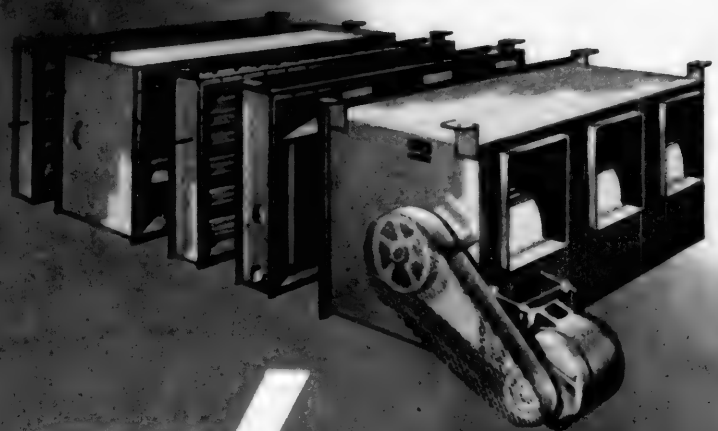
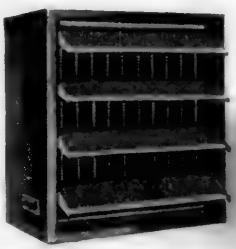


Centrifugal Unit Heaters



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Industry Leaders Attend Dedication Of Million-Dollar Laboratory at Purdue

Unexcelled facilities for studying the effect of environment upon man and animals were formally dedicated on June 3 in a ceremony at Purdue University, Lafayette, Ind., attended by over 160 persons, many leaders in the refrigeration and air conditioning industry.

The million-dollar Ray W. Herrick laboratories for basic research in air conditioning and refrigeration was named for its principal donor, the chairman of the board of Tecumseh Products Company. It is under the direction of both Purdue's Schools of Agriculture and Mechanical Engineering. Prof. Fred N. Andrews summarized the purposes of the new research center in his talk on "Man and His Environment" in pointing out that in exploring polar regions, desert, jungle, and outer space, man can no longer afford to avoid intensive work toward solution of the problems of environment. The problems range from that of comfort conditioning for humans to control of environment for animals to increase food production.

Fundamental research at the Herrick Labortories will include the reduction of heat and mass transfer phenomena to workable formulas, investigation of refrigerant viscosities, and many aspects of environment. Chambers are so devised, for instance, that floor and air temperatures can be varied, independently. Visitors were greatly impressed by the adequacy of the lab's controls and instrumentation.

Dr. Frederick L. Hovde, president of the University, formally accepted the new building from Walter Scholer, architect.

Among those present for the ceremonies were, left to right above, Dr. George A. Hawkins, dean of engineering; Prof. Paul Chenea, head of the School of Mechanical Engineering; Melvin A. Ramsey, consulting engineer, Worthington Corp., East Orange, N. J.; William F. Freije, William F. Freije, Inc. Indianapolis, contractors and engineers who built the environmental chambers; and Prof. Harry Solberg, associate dean of engineering.

Ray M. Herrick, principal donor of the new Herrick Laboratories for Refrigeration and Climate Control at Purdue University is shown left above with Dr. R. B. Stewart, vice-president and treasurer of the University.

Left to right, Prof. Jack B. Chaddock, who discussed "The Relation Between Heat and Mass Transfer in Air Conditioning Processes"; Prof. William E. Fontaine, co-director of the Laboratories; John E. Haines, vice-president, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., representing one of the 20 donors; and Prof. Fred Andrews, who spoke on man's environment.

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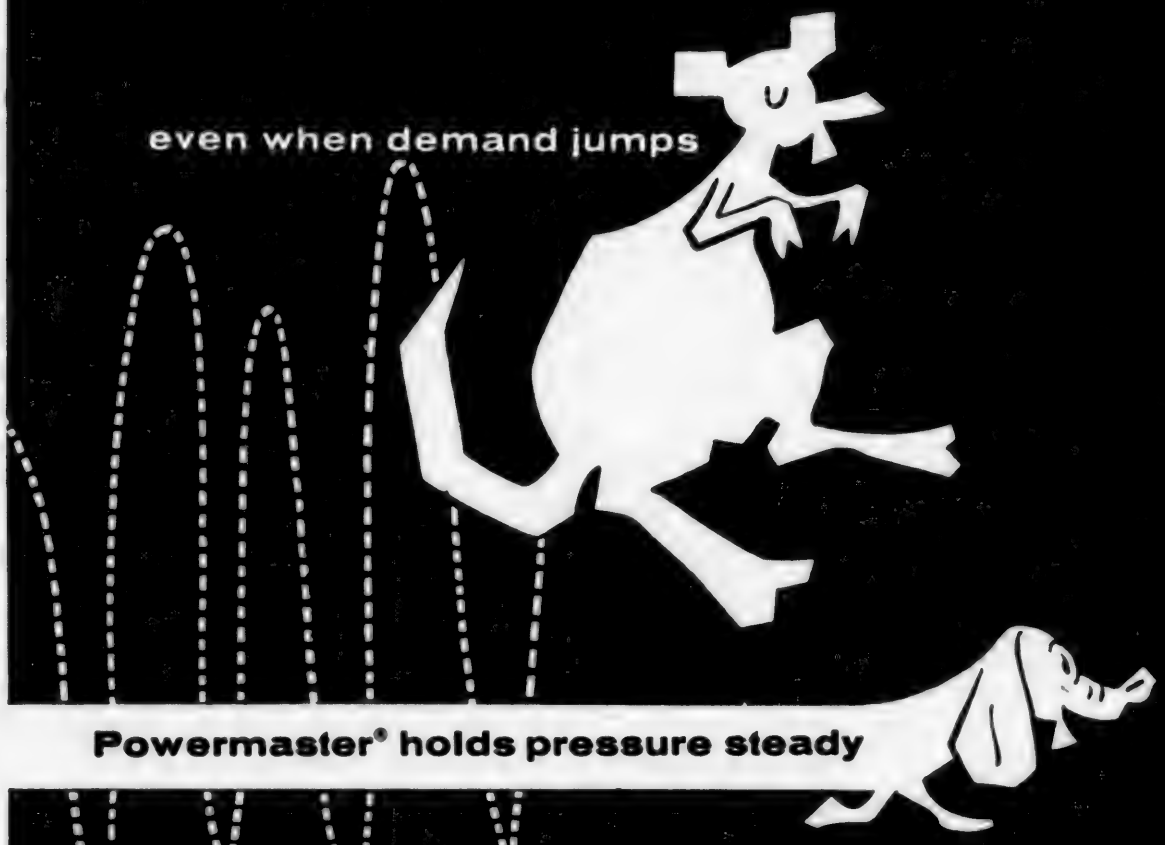

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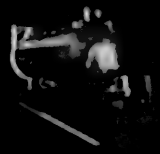

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Forty-Eight Colleges Name Top Students To Receive Industrial Press Handbook Award

For the second year The Industrial Press, publishers of *Air conditioning, Heating and Ventilating* and technical books, has presented and award to the outstanding student in courses involving heating, ventilating and air conditioning in a number of colleges and universities in the United States. The award consisted of a *Handbook of Air Conditioning, Heating and Ventilating* and a Certificate.

This year the award was made to 51 students in 48 colleges, some colleges having had more than one course in this group of subjects. The students who won the award were:

Jerry Evans Jackson, Auburn University; Dean Norris, Arizona State University; Glen W. Dorow, Case Institute of Technology; John A. Gaulden, Clemson A & M College; Thomas J. Gilheany and Syiatoslov Liapunov, Columbia University.

Also Robert Shaw, Jr., Cornell University; Worth Cotton, Duke University; Claude Stephen Rhea, Georgia Institute of Technology; Harry I. Cohen, Howard University; William J. Grennan, Kansas State College; Charles E. Stadtlander, Louisiana Polytechnic Institute, and Neal N. Nushart, Marquette University.

Also P. Jaime Wahnon, and Franklin B. Rodgers, Massachusetts Institute of Technology; David C. McCormick, Michigan College of Mining & Technology; Robert Dale Hammer, Milwaukee School of Engineering; Wallace John Haugan, Montana State College; Thomas J. Bodvig, North Dakota State College; Jay W. Feldmann, Northwestern University, and James Kellogg Nelson, The Ohio State University.

Also Bert E. Bailey, Oklahoma State University; Kenneth G. Wall, Oregon State College; John T. Melnick, Pennsylvania State University; Michael J. Masterson, State University of Washington; James B. Davenport, Syracuse University; James O. Nelson and David C. Osborne, Texas Technological College.

Also Jerry L. Cessor, University of Arizona; Richard Clarence Walker, University of Alabama; Clifford Michael Scofield, University of Colorado; Thomas N. Grogean, University of Dayton; Charles B. Woodward, University of Delaware; Karl Anton Katzor, University of Florida; Norman Joseph McCormick, University of Illinois; Chester A. Friend, University of Maryland, and Gerald C. Groff, University of Minnestoa.

Also J. D. Gaines, University of Missouri; Bruce Fagon, University of Notre Dame; Tom Yarbrough Rush, Jr., University of Oklahoma; M. T. O'Connor, University of Pittsburgh; Lief Martin Jensen, University of Southern California; Benny L. Collings, University of Tennessee, and William Danny Turner, University of Texas.

Also Harry O. Patterson, University of Wyoming; Robert D. Brady, University of Washington; George H. Kerckhove, University of Wisconsin; Ted Louis Lee, Vanderbilt University; Francis M. Perry, Villanova University; William Baker Lupton, Jr., Virginia Polytechnic Institute, and Jack Kimmel Gerhard, West Virginia University.

Says Air Conditioning Experiment May Revolutionize School Design

The first stage has been completed in a unique demonstration proving that new, fully air-conditioned schools can be built at a cost no greater, and probably even less than, non-air-conditioned schools, according to an announcement by American Air Filter Co., Inc. The experiment, in Pinellas County, Florida, promises to have far-reaching effects on school design all over the country.

Elsewhere in the U.S., more than 200 fully air-conditioned public schools have been completed, and in many cases architects and educational officials have reported that they seem to cost no more than non-air-conditioned buildings, when designed for air conditioning at the outset. But this, in the nature of things, has remained a matter of opinion.

In 1958 the Syracuse School Board (as did school boards in a number of other cities) commissioned a firm of architects to make detailed studies, based on completed alternative designs, of the relative cost of a school with and without air conditioning, and came up with a theoretical saving of $68,995 on a $2,033,000 building. Syracuse went ahead with the air-conditioned school, which was built at a cost close to the original estimate, but what the actual cost of the non-air-conditioned school would have been was not, and could not be, determined with equal certainty.

Two Schools For Comparison

Resolving even this doubt, Pinellas County is building two such comparison schools—schools designed to identical educational specifications down to the last detail, by different architects, each striving to produce the maximum in educational value per building dollar. As impartial referees, officials of the Pinellas County Board of Public Instruction made sure in advance of bidding on the two jobs that there were no significant differences between them not directly attributable to, and practicable only with, year-round air conditioning itself.

The Pinellas Park Junior High School, designed by architect Charles L. Colwell, is an attractive functional school designed in accordance with regular Florida practice. It is a cluster plan for maximum breeze cooling and is being built without air conditioning. The base bid for this school, received last November (less the cost of a sewage lift station not included in the base bid for the comparison school) was $584,749. On the basis of nominal area, as figured by the Florida State Board of Education,

(Continued on page 16)

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SCHOOL CONDITIONING

(Continued from page 14)

this works out to a cost of $8.80 per sq. ft.—or somewhat below the average for schools in the St. Petersburg area.

The Oak Grove Junior High School, designed by architects Bruce and Parrish, with the assistance of technical consultant Henry Wright of New York City, employs a more compact scheme made possible by air conditioning. Healy & Latimer, St. Petersburg, served as consulting mechanical engineers to the architects on both projects. The base bid for the Oak Grove school, received April 13th, was $582,900. This was $1,849 less than the corresponding figure for the non-air-conditioned school. (The possibility that the difference was due to the time-lapse between the bids was precluded by a small, but definite *increase* in the construction cost index during the interim.) This meant that Pinellas County is to get somewhat less gross area (66,175) as compared with 66,468 sq ft, for somewhat more per square foot ($8.89 instead of $8.80), but at a lower cost overall. Educational space in the two schools is virtually identical, being 49,159 sq ft in the air-conditioned Oak Grove School, and 47,880 sq ft in the non-air-conditioned Pinellas Park buildings. When various alternates involved in the bidding are taken into account, the comparison becomes more complicated, but remains favorable to air conditioning.

Since the boiler and piping at Oak Grove are sized for the ultimate 32 classrooms, and there is a good chance that the air conditioning compressors being installed in the first stage of construction will prove adequate for another eight classrooms, it is more than likely that the cost comparison between the schools will be even more favorable after the additional rooms have been built in both cases. At Pinellas Park, almost no preparations for heating the additional space were required by the type of system used. Most of the Oak Grove construction cost savings were in the classroom portion of the building, and will be repeated when additional classrooms are added. Taking these things into account, it seems probable that the ultimate air-conditioned school will turn out to be considerably cheaper than its non-air-conditioned counterpart; in any event, this will not remain in doubt for long, since the additions are likely to be made within a year or so, in both cases.

Heating, Ventilating Costs Are Low

This is all the more remarkable in view of the fact that the cost for heating and ventilating equipment in the non-air-conditioned school was very low. As shown by the contractor's cost breakdown supplied to the School Board as a basis for periodic payments, it was only $0.67 per sq ft, or only a little more than one-half the national average. This seems to clinch the argument for air-conditioned schools: If they can be built for less in Florida, where heating costs are low and air conditioning costs may be assumed to be somewhat higher than elsewhere, then certainly air-conditioned schools can be built for less than non-air-conditioned schools in other parts of the U.S., where these factors are reversed, the American Air Filter Company statement continues.

Expressed in cost per square foot, the designers of the Oak Grove School had to "make up" for a difference between about $1.60 for year 'round air conditioning, and $0.67 for heating alone. This difference of $0.93 compares with a probable average difference of $0.70 in parts of the country where the normally-used heating and ventilating system is more complete. This they succeeded in doing.

Pinellas County is not building otherwise identical air-conditioned and non-air-conditioned schools simply to establish the fact that air conditioning can be had at no extra cost, and even at a saving. School Superintendent Floyd T. Christian has other research goals. These include a comparison of the two schools on the basis of:

1. *Operating expenses*, including the cost of operating the air conditioning equipment, less savings due to reduced cleaning and other maintenance costs

2. *Attendance*, plus any other evidence of the effects of air conditioning on the health and morale of students and teachers

3. *Increased use of school facilities*, including nighttime and summertime usage, community functions and use for adult education

4. *Educational effectiveness*, evaluation of which is to be the objective of an ambitious study employing the already extensive facilities of the Pinellas County Board of Public Instruction, and for which a grant has been requested from the U.S. Department of Health, Education and Welfare.

Mechanical Systems Compared

In the *Pinellas Park* school, classrooms are nearly square and have windows on two sides or exhaust fans to meet Florida State regulations regarding breeze cooling. Separate classroom and other buildings are connected by covered, open air walks employing a concreate "bent" structure. Heating is by residential-type gas-fired furnaces, serving adjoining classrooms.

In the *Oak Grove* school, classrooms are rectangular, with the narrower dimension abutting on the corridor, cutting down on corridor length and reducing the distance which students must travel to different parts of the school. Window sills are high, since windows are not relied upon for ventilation cooling, and have lockers beneath, facing the corridors. Winter heating and thermostatically-controlled ventilation, together with summer air conditioning, are provided by air conditioning unit ventilators located on the inside walls, where the adjoining classrooms are separated by a continuous space for pipes, wiring and for admitting ventilation air. These unit ventilators are manufactured by the Herman Nelson Div., American Air Filter Company, Inc. A gas-fired boiler and natural-gas-fuel, internal-combustion-powered air-conditioning compressors are located in a separate building near the cafeteria kitchen and gymnasium shower rooms.

(News of the Month Continued on page 134)

Air-Lift† for modern

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Air-Lift is a new concept of coordinated products and services from American-Standard Industrial Division. Through Air-Lift, you get one-source responsibility for all the year-round air-conditioning equipment demanded by today's new and renewed office buildings. Air-Lift helps you lift their efficiency through better control of the indoor climate.

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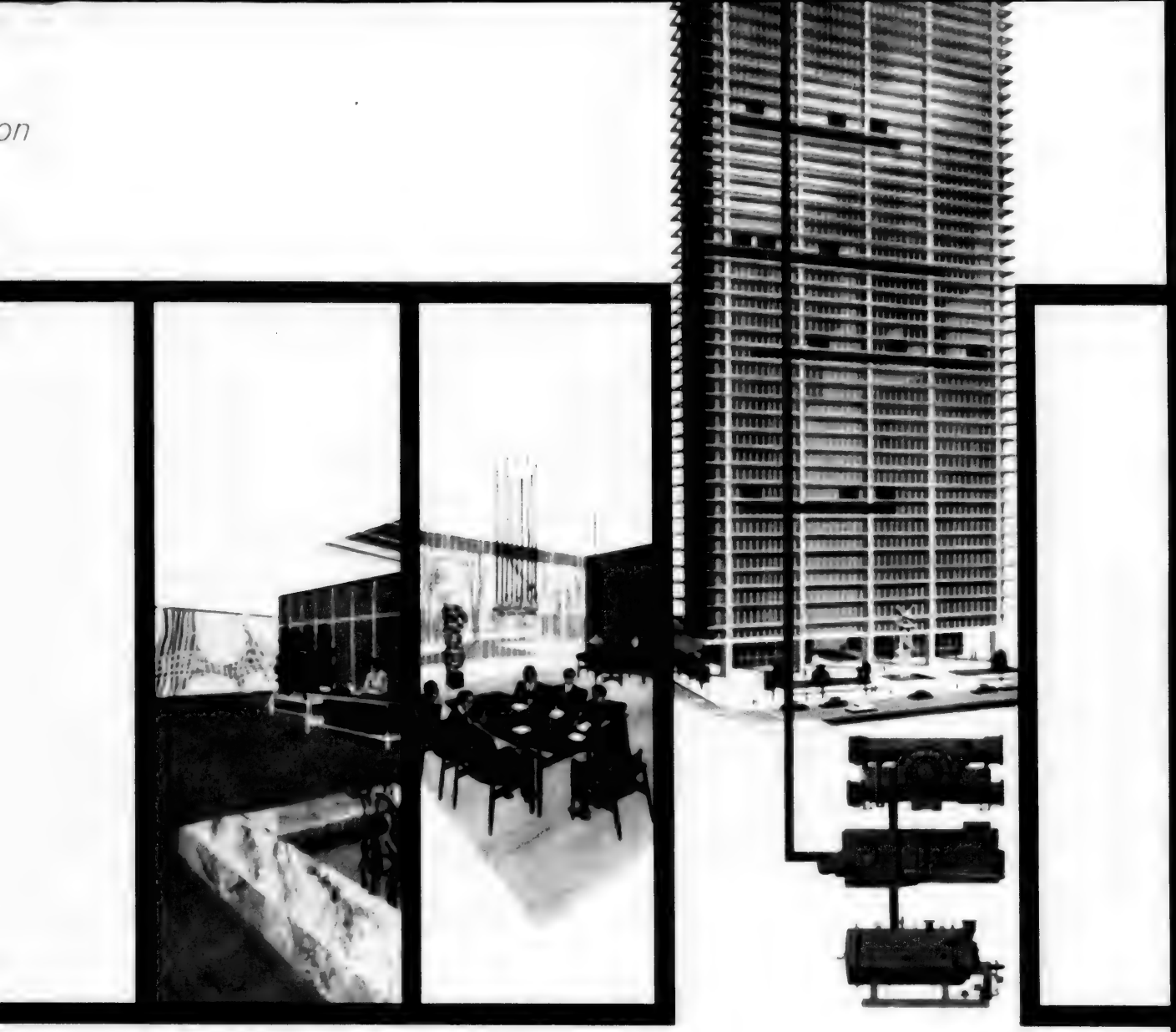

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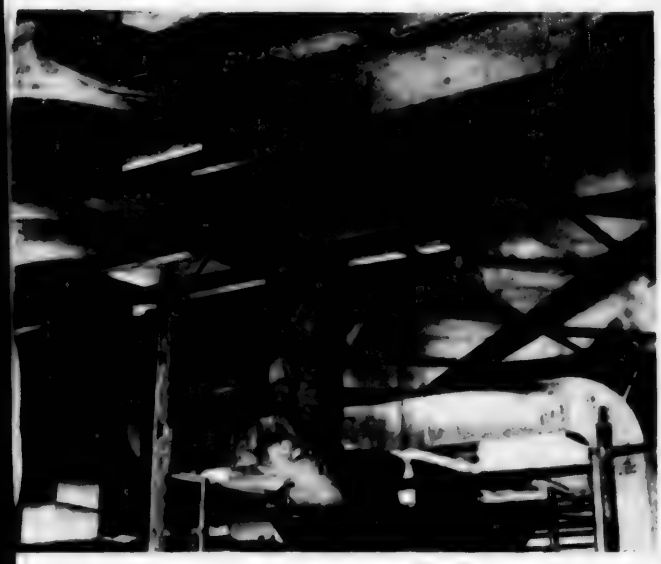
Right, PPG insulation is easily cut to size on the job. Left, Foreman Charles W. Booth, of Acheson Sheet Metal Company, supervises installation of ductwork. PPG Neoprene-coated Duct Liner meets all requirements of NBFU Bulletins No. 90-A and 90-B for ducts, and bears the label of Underwriters' Laboratories, Inc.



The inside story on a hush-up job in Tampa

(with PPG Fiber Glass Insulation, of course!)

It will be quiet, as well as comfortable around the new State Agency Building at Tampa, Florida, because PPG Fiber Glass Insulation has been installed in the ductwork of the heating and air conditioning system.

Job foreman Charles W. Booth of Acheson Sheet Metal Company, Jacksonville, installers of the ductwork, reports that the long life-expectancy of PPG Neoprene-coated Fiber Glass is of great importance in the choice of this insulation, because of the difficulty of replacement in a duct system.

It's what's inside that counts!

Mr. Booth says that PPG Insulation has extraordinary sound-deadening qualities which eliminate fan noise, has excellent thermal-barrier characteristics, and low resistance to air flow. In addition to ease of handling and installation, it will not be affected by humidity, won't swell, rot or decay . . . very important in Tampa-types of climates!

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Available in a range of sizes, densities, and facings to meet any insulation specification. For more information, contact your nearest Fiber Glass Sales Office, or write *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Penna.*

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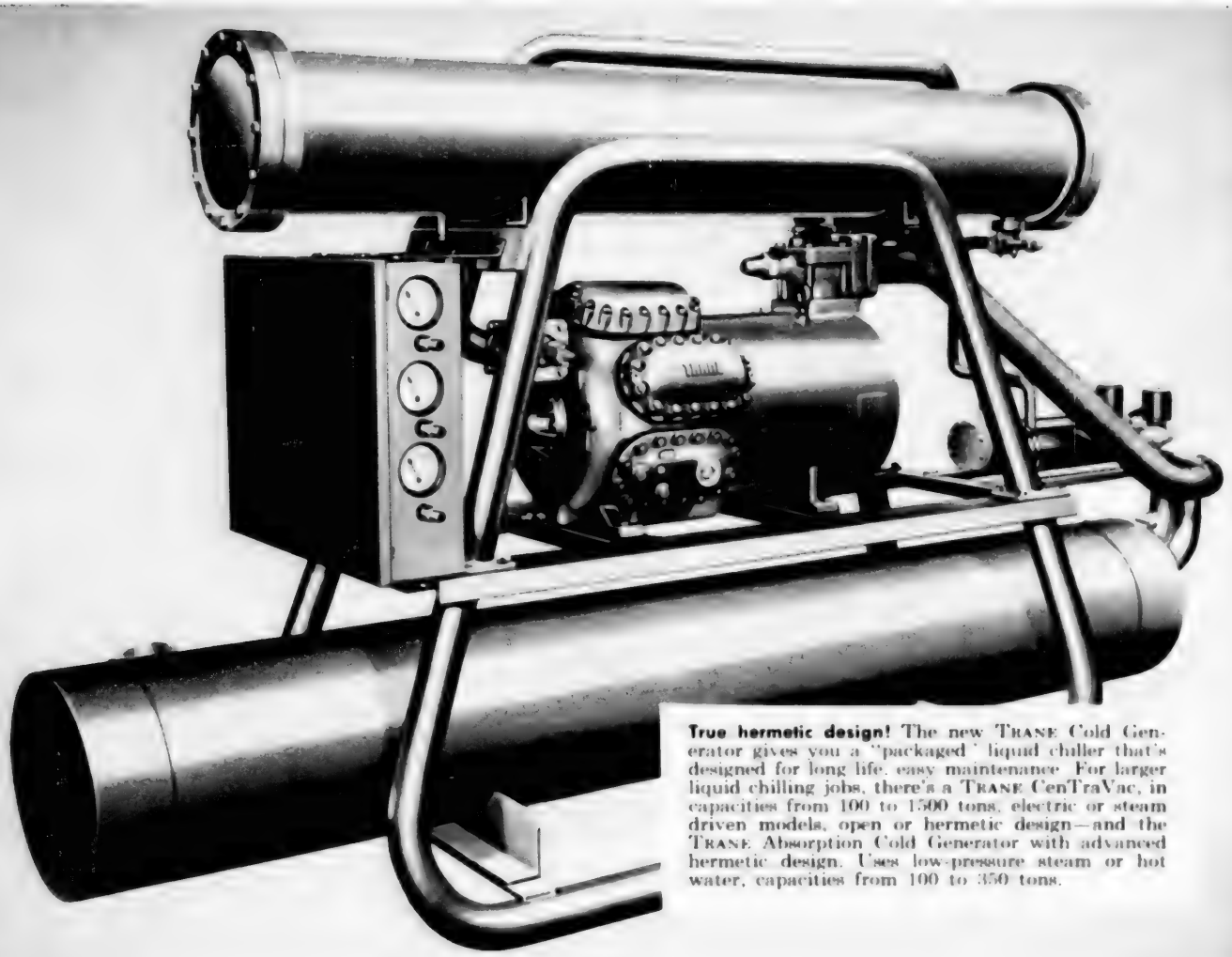
For faster installation, make it a new Trane



True hermetic design! The new TRANE Cold Generator gives you a "packaged" liquid chiller that's designed for long life, easy maintenance. For larger liquid chilling jobs, there's a TRANE CenTraVac, in capacities from 100 to 1500 tons, electric or steam driven models, open or hermetic design—and the TRANE Absorption Cold Generator with advanced hermetic design. Uses low-pressure steam or hot water, capacities from 100 to 350 tons.

Now! A hermetic model of the Trane Reciprocating Compressor!

Here's a new, efficient Reciprocating Compressor that's *fully hermetic*, designed for the more rigorous demands of R-22. This unit is of single-housing construction. Motor and compressor are in one shell, with a bolted end cover for easy access. This minimizes alignment problems experienced with other hermetic compressors that have 2-part housing.

The new TRANE Hermetic Reciprocating Compressor has multi-step capacity control that saves power by reducing starting, stopping. And the truly hermetic design eliminates crankshaft seal and coupling to provide quiet operation, simplified installation, longer life.

Check these advanced TRANE features:

- **Designed for R-22 and R-12** (not a converted R-12 machine).
- **Single-housing construction** for simplified installation, trouble-free operation, easy access for maintenance.
- **Multi-step capacity control** reduces starting, stopping, saves power.
- **Exclusive internal thermal protector,** located in the motor windings, protects against any condition that causes high motor temperatures.
- **Large suction chamber** and cylinder head safety springs provide protection against refrigerant slugging.
- **Available** in sizes from 10 to 100 tons.

trouble-free operation, Hermetic Cold Generator

Here's a "packaged" liquid chiller of advanced design for a wide variety of process or comfort applications

When you plan your next refrigeration job—for comfort or process cooling—look at this new TRANE Reciprocating Cold Generator. It's *hermetic*, to provide you with a vastly improved machine for a wide variety of applications. It features an all-new TRANE Hermetic Compressor (illustrated and described below); a new chiller; a new condenser with a built-in sub-cooler that eliminates the need for a heat exchanger in built-up systems. All of these major components are arranged to provide an amazingly compact and efficient machine; and all three are engineered and built by TRANE. They are designed and built together to work together.

The new TRANE Reciprocating Cold Generators are designed for either R-22 or R-12—except the 10-ton model that uses R-12 only. Exceptionally compact and lightweight, the units will pass easily through a standard 36"-wide door. Available with pneumatic or electric controls, they are preassembled, prewired. There is no on-the-job wiring except for lead-in. The advanced design assures maximum efficiency on a tons-per-hp basis. They operate quietly, efficiently . . . are easy to maintain.

Want more facts? For complete information and specifications on the new TRANE Hermetic Cold Generator—and the complete line of TRANE Water Chillers from 10 to 1500 tons, contact your nearby TRANE Sales Office; or write TRANE, La Crosse, Wisconsin.

Check these advanced TRANE features:

- **All major components,** chiller, condenser, compressor, designed and built by TRANE.
- **Advanced hermetic design** assures maximum efficiency, simplified maintenance and installation.
- **Compact size;** small enough to pass through a standard 36"-wide commercial door.
- **Packaged design;** factory-wired and assembled to cut on-the-job labor. Pneumatic or electric control panel mounted and prewired.
- **Versatile.** May be used for any process or comfort liquid cooling application . . . to maintain constant temperature for electro-plating baths and other critical operations. Units available for use with evaporative or air-cooled condensers.

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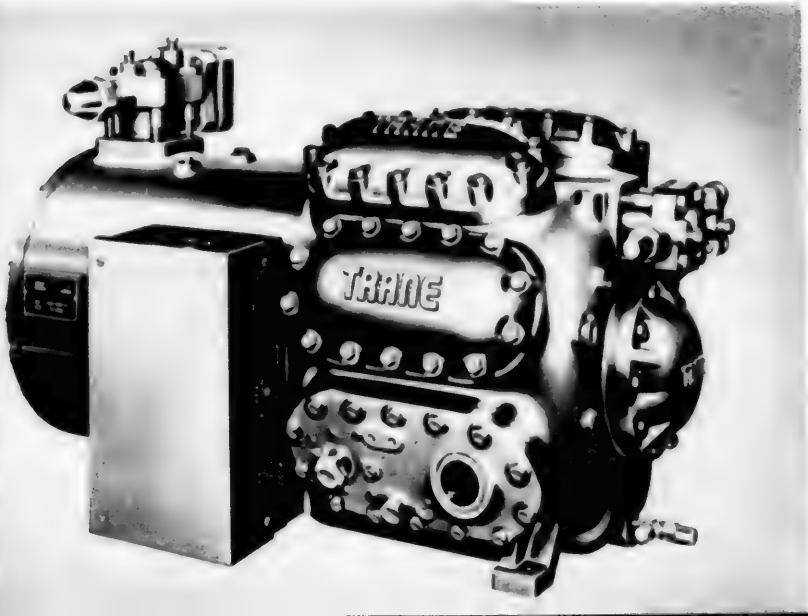

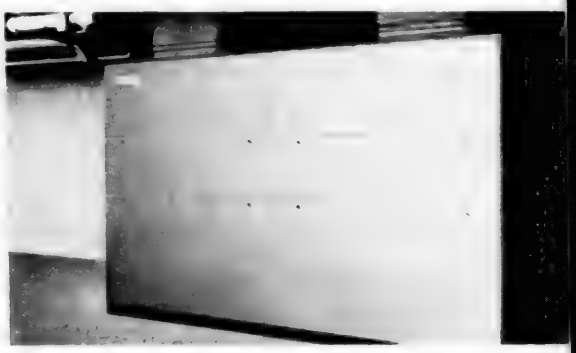

Trane Commercial Self-Contained Air Conditioners feature the new TRANE Hermetic Compressor. Quiet and compact, these units provide maximum cooling comfort for commercial and industrial applications. Feature new TRANE Sigma-Flo Fin Coils for greater efficiency in less space. Air or water-cooled models in sizes from 10 to 50 tons.

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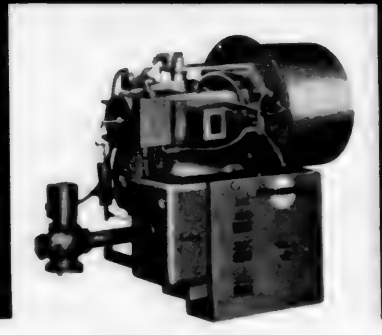

Completely packaged Ray Forced Draft Burner

New Ray Forced Draft burners are available two ways to meet your needs and budget. Burner alone, or as a completely packaged combustion unit. Both offer all these exclusive performance features:

FAST INSTALLATION—Completely contained wiring is expertly done at the Ray factory. Field connecting is limited to a minimum with only simple external fuel and electrical connections to be made.

AMAZING FUEL ECONOMY—Ray is the only burner offering full modulation for both gas and oil. Ends step-firing and starting with a puff. With full modulation, burner closely follows load demand, maintaining steam or hot water capacity at all times, with resultant efficiency and economy.

SMOOTH PERFORMANCE—Smooth low to high fire transition is supplied by the Ray MODUFIRE System, along with guaranteed low-fire start. Burner gradually increases from low flame to high, then instantly drops back to low when boiler demands are met.

NO SMOKE, NO STACK—Clean burning from the start. Forced Draft design eliminates the need for an unsightly stack.

FIT ANY BOILER TYPE—These fully automatic units are available in three sizes to fit any type boiler and have maximum capacities ranging from 7 to 30 gallons per hour.

LOCAL FACTORY SERVICE—Only Ray offers a national network of factory-trained dealers, to cut down-time with right-now service and parts.

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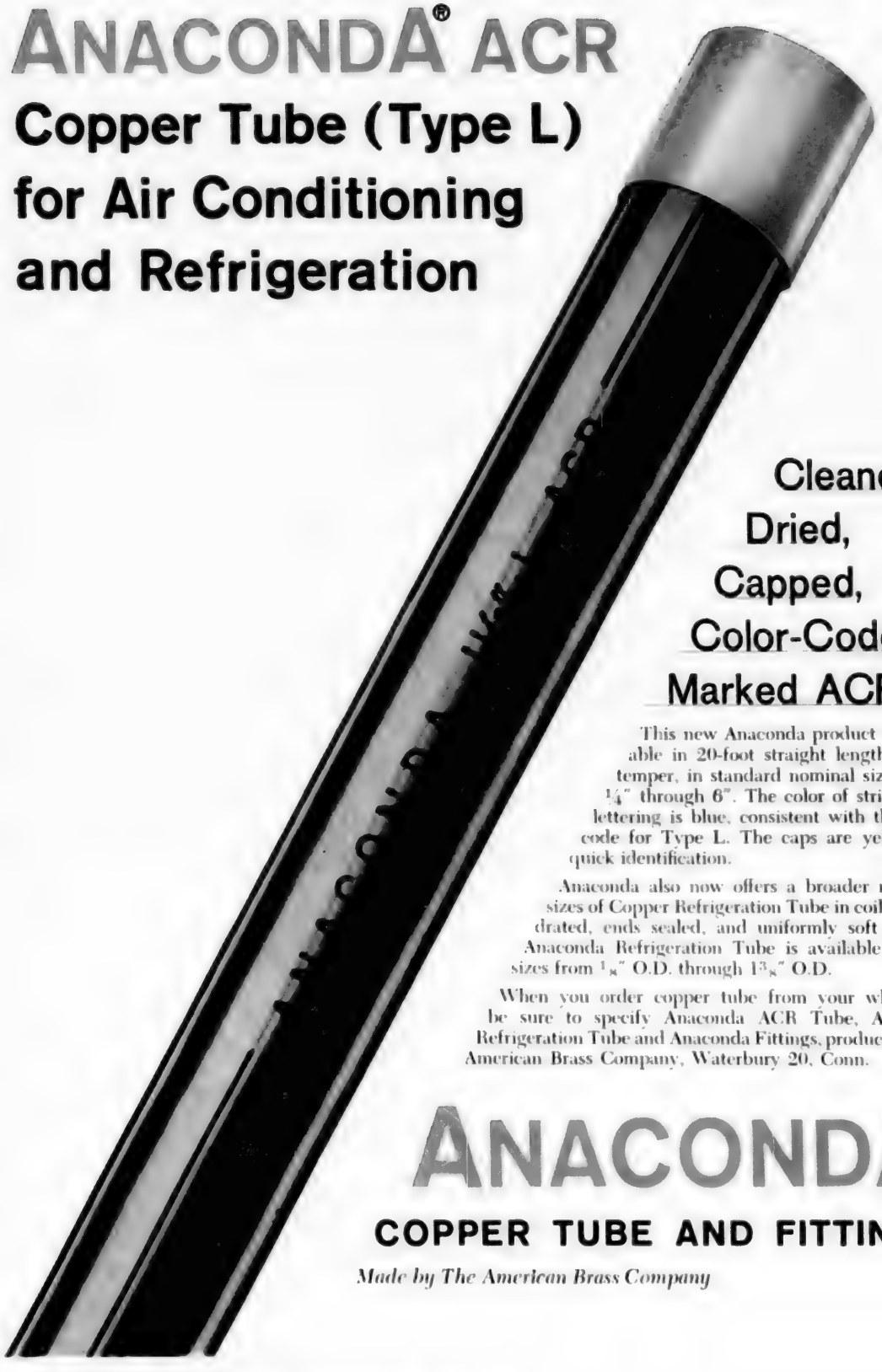
ANACONDA® ACR
Copper Tube (Type L) for Air Conditioning and Refrigeration



Cleaned, Dried, Capped, Color-Coded, Marked ACR.

This new Anaconda product is available in 20-foot straight lengths, hard temper, in standard nominal sizes from ¼" through 6". The color of stripes and lettering is blue, consistent with the color code for Type L. The caps are yellow for quick identification.

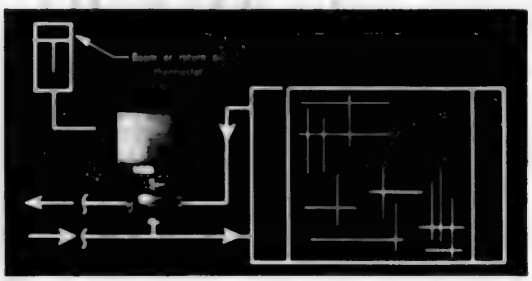
Anaconda also now offers a broader range of sizes of Copper Refrigeration Tube in coils—dehydrated, ends sealed, and uniformly soft temper. Anaconda Refrigeration Tube is available now in sizes from ⅛" O.D. through 1⅜" O.D.

When you order copper tube from your wholesaler be sure to specify Anaconda ACR Tube, Anaconda Refrigeration Tube and Anaconda Fittings, products of The American Brass Company, Waterbury 20, Conn.

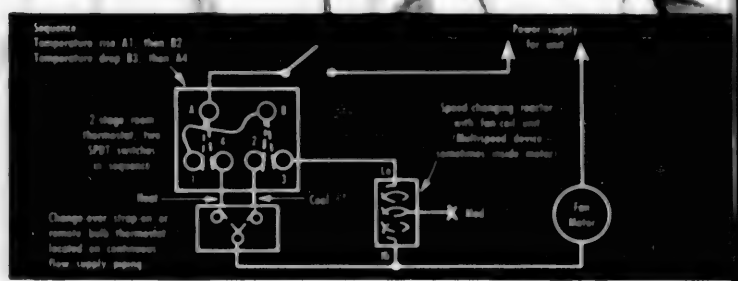
ANACONDA®
COPPER TUBE AND FITTINGS

Made by The American Brass Company

Tips on control

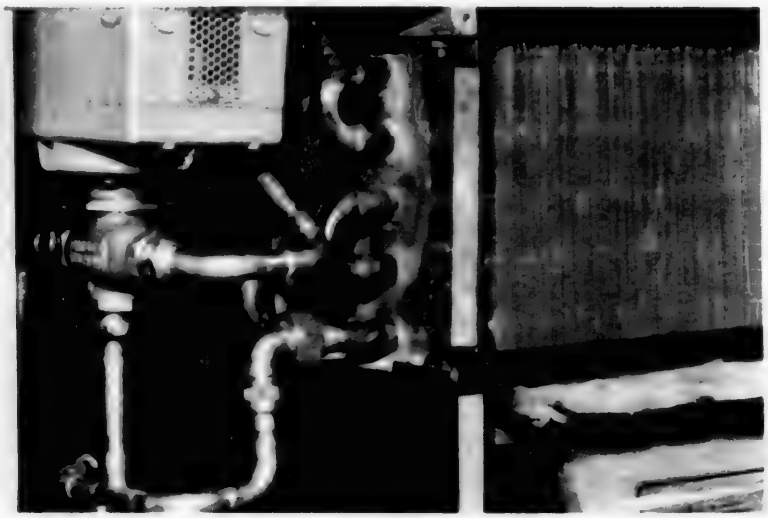


Fan-coil control with continuous fan operation and thermostatically controlled Barber-Colman transistorized coil valve.


Sequence
Temperature rise A1, then B2
Temperature drop B3, then A4
Power supply for unit
2 stage room thermostat, Para SPDT switches in sequence
Speed changing resistor with fan coil unit
Multispeed device
Heat
Cool
Change-over strap on or remote bulb thermostat located on condenser
Flow supply piping
Fan Motor

Elementary diagram of two-stage fan speed control for fan coil units with automatic summer-winter change-over. Descriptive literature with schematic control diagrams available upon request.

# of fan-coil units



Proper automatic control is essential to user satisfaction. Here are facts to consider in selecting control hookups for heating, or heating and cooling installations.

Fan-coil units consist basically of a cabinet, fan, and motor, and a finned heat transfer surface through which hot or chilled water may be circulated. Satisfactory heating and cooling performance can be assured with proper *automatic* controls. (*Manual* on-off operation has frequently been the cause of inadequate performance and dissatisfaction.)

Four basic types of control systems are commonly used:

1. Proportional control using a coil valve and thermostat. In most cases this is the ideal control method. It represents a "high-quality job" and provides excellent temperature uniformity. Also, the fan operates continuously, avoiding the disadvantage of changes in sound level.

A three-way valve may be used on the coil, but a two-way valve should be considered because it provides superior throttling performance. When a two-way valve is used, a means of regulating the supply main pressure should be provided.

2. On-off control using a coil valve and thermostat. This type of control has the advantage of continuous fan operation with the coil valve opening or closing by thermostat control. When a motor-operated valve is used, two-position valve control is simple and dependable. Excellent results are produced at a cost slightly less than for proportional control. Normally, however, it does not provide quite as accurate control of temperature uniformity as proportional control.

3. Room thermostat control of fan only. This is the simplest automatic control system for fan-coil units. However, when used for cooling, it may introduce the possibility of condensation with resultant dripping of water. This disadvantage can be avoided or, in some instances, eliminated by using a two-stage thermostat which minimizes the fan-off time. The two-stage thermostat also improves control performance.

4. Combination control using a two-stage thermostat controlling the fan and a two-position coil valve in sequence. This control system is more refined than No. 2 or 3 above. It eliminates the possibility of condensation encountered when only the fan is cycled.

Circuits are arranged for continuous fan operation. Upon the initial call for heating or cooling, the coil valve opens and the fan runs at low speed. When additional heating or cooling is required, the fan is shifted to the higher speed by a two-stage thermostat.

Outdoor reset of winter supply water temperature is recommended to provide optimum results during heating operation with any of the above-described systems.

For complete data, ask for "Application Manual Brochure on Control of Fan-Coil Units."

BARBER COLMAN

BARBER-COLMAN COMPANY

Dept. G, 1302 Rock Street, Rockford, Illinois

Architects. I. M. PEI AND ASSOCIATES, New York, in association with ROGERS AND BUTLER, New York
General Contractor. WEBB & KNAPP CONSTRUCTION CORP., New York • *Consulting Engineer:* JAROS, BAUM & BOLLES, New York
Air Conditioning, Heating, Plumbing Contractor: KERBY SAUNDERS, INC., New York

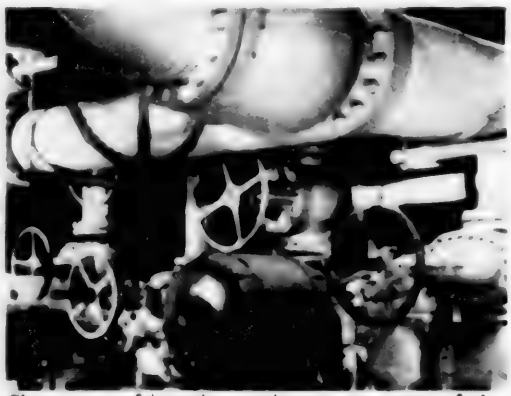
JENKINS VALVES were installed to control all service lines

The name of Webb and Knapp, Inc., owner of the new Denver Hilton, would appear in any list of people who know most about building . . especially about building for efficient, economical operation.

Outstanding in the world of building, too, are the architects, engineers and contractors who collaborated in the design and construction of the magnificent 884-room Denver Hilton.

Few buildings have had so much knowledge and experience applied to assure trouble-free operation. And, one of the important steps taken to avoid maintenance expense and interruptions of service was the installation of *Jenkins Valves*. Heating, plumbing and air conditioning lines are controlled by valves bearing the famous Jenkins Diamond mark of reliability.

When you specify or install valves, remember that the valves preferred by so many of the country's top building experts for almost a century cost no more. In the end, they can cost less Jenkins Bros., 100 Park Avenue, New York.



Shown on refrigeration equipment are some of the hundreds of Jenkins Valves of bronze, iron and stainless steel in The Denver Hilton.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864 Jenkins Bros.

Sold Through Leading Distributors Everywhere

when you want it

Quiet

you want the new

McQuay SEASONVENT

heating and ventilating unit

The highly efficient sound-absorbing plenum sections and internally mounted fan motors make the McQuay Seasonvent quiet in operation—the ideal unit for auditoriums, theatres and similar installations. The Seasonvent is super efficient, too, and extremely versatile, with nine sizes for low static applications (0" to 1¼") and seven sizes for high static operations (1" to 2"), with capacities from 1250 to 15,000 cfm.

for horizontal vertical or wall mounting arrangements

When you want quiet operation, you'll surely want the new, quiet Seasonvent. Call your McQuay representative for complete information, or write McQuay, Inc., 1619 Broadway Street N. E., Minneapolis 13, Minnesota.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

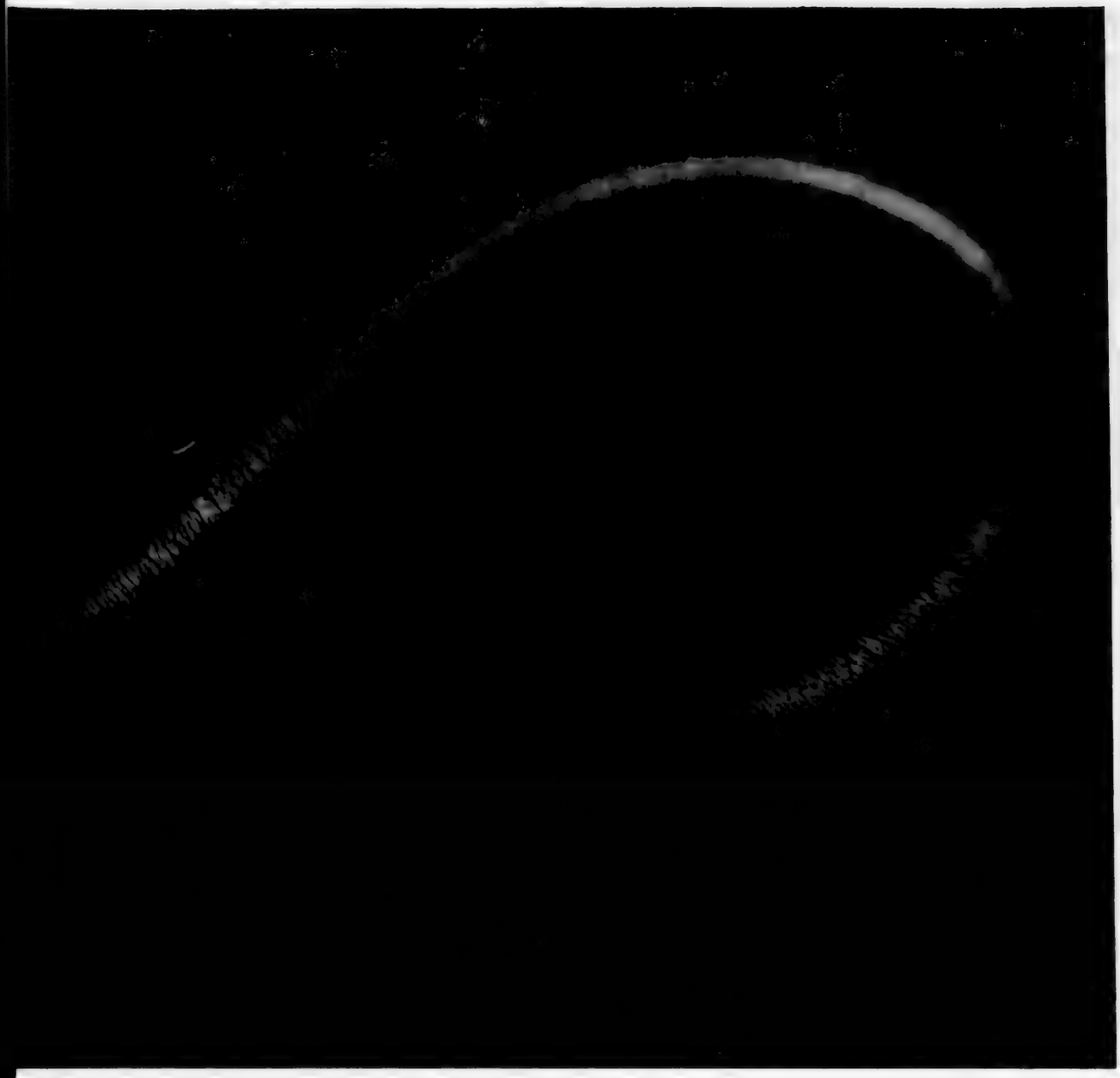
McQuay Means Quality

Stop pipe condensation with the built-in vapor barrier of J-M Aerotube

... THE FLEXIBLE, FOAMED PLASTIC PIPE INSULATION THAT CUTS INSTALLATION COSTS IN HALF.

For heating, plumbing and air-conditioning service—wherever sweating or condensation is a problem—Johns-Manville Aerotube® is the economical solution.

Aerotube is a tubular pipe insulation for use at temperatures from 32F to 220F (double layer of Aerotube permits range of 0F to 220F). Its closed cell structure stops the passage of moisture. This built-in vapor barrier, plus the insulating effectiveness of Aerotube, will prevent condensation under normal design conditions on indoor lines. What's more, you



can depend upon Aerotube to maintain its effectiveness indefinitely.

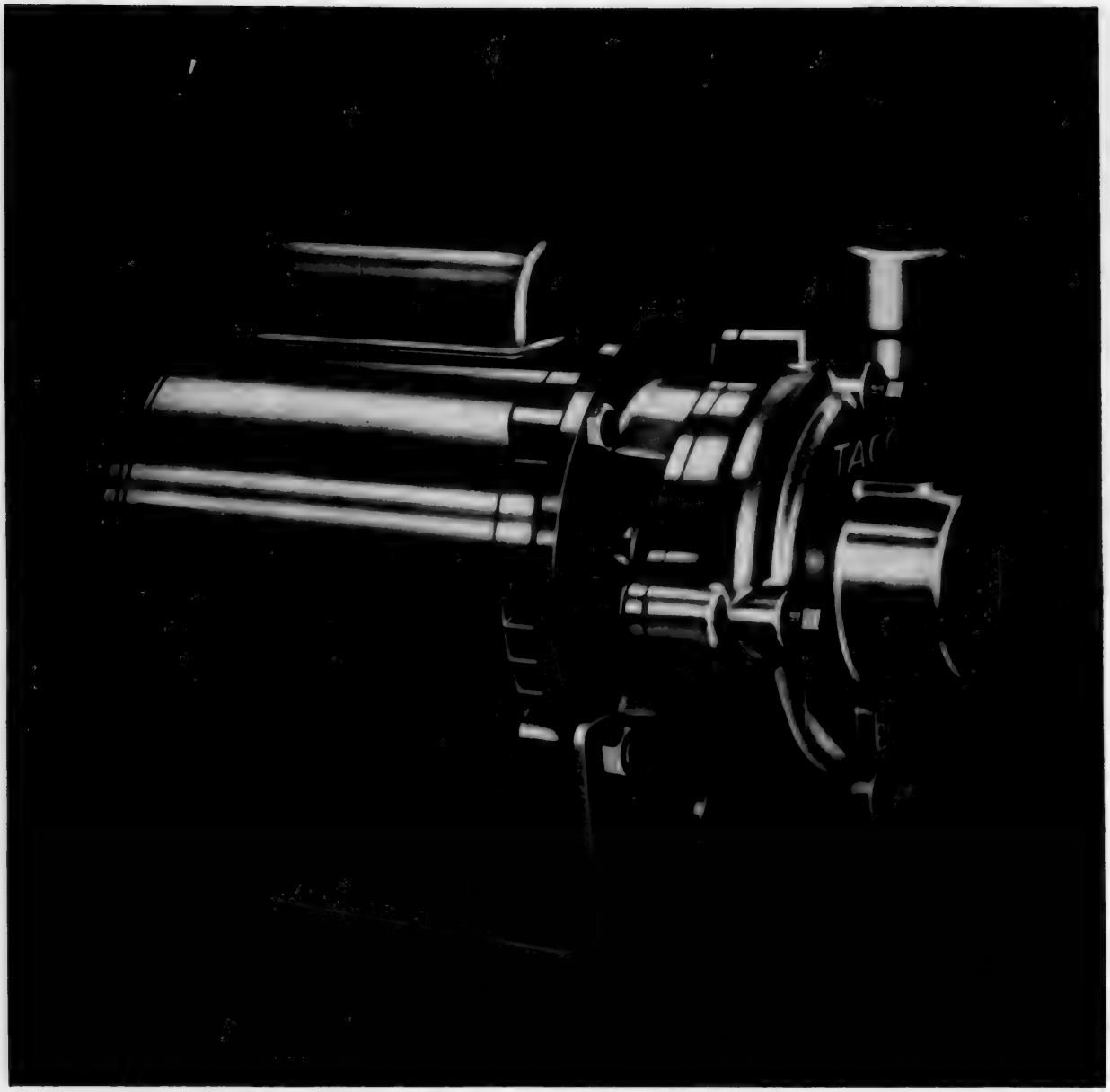
Aerotube is the easiest-to-install pipe insulation available today. On a straight run of pipe or the most complex bend, Aerotube's six-foot lengths go on quickly. For connected pipe, just slit Aerotube longitudinally, snap it on, and seal it up! You'll discover that labor costs are substantially reduced when Aerotube is chosen to solve condensation problems.

Available in a wide range of thicknesses, there's an Aerotube insulation that meets your particular needs. For full information, send for brochure IN-213A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

Even the most complex bend is easy to insulate with flexible J-M Aerotube.

JOHNS-MANVILLE

AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE



Lubricate in 1970

That's right. If you put the TACO General Purpose Pump into operation today, you can forget about lubricating it until 1970! Actually the motor is permanently lubricated, but we recommend re-packing the bearings every ten years. No other parts of this rugged pump *require* lubrication! Freedom from lubrication worries is just one of many reasons why the TACO General Purpose Pump is ideal for use in air conditioning systems, commercial installations, laundry equipment, swimming pools, and hundreds of other applications. Design has been so simplified that any servicing necessary can be done in the field, with tools ordinarily carried by all service men. Compact and lightweight, the TACO General Purpose Pump saves installation time too. And its dependable performance saves costly "call backs" In short, it provides a better all around return for your investment. Get complete specifications now. All products in the *complete* TACO Line are "efficiency engineered" to provide maximum performance and economy in all your installations. Write TACO HEATERS, INCORPORATED, 1160 Cranston Street, Cranston 9, Rhode Island.

TACO

SERVING THE HYDRONIC INDUSTRY SINCE 1920

update your "specs"

ON

G-B GLASS FIBER INSULATIONS

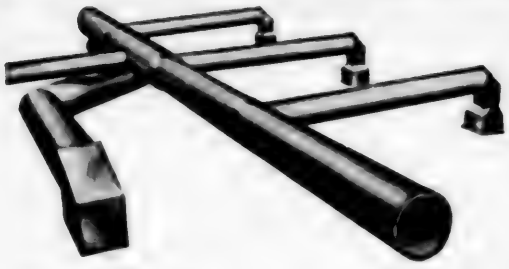
Technical bulletins on the Gustin-Bacon glass fiber insulations shown here, including complete specifications, have been revised and reprinted from time to time. To be sure your literature file is up-to-date, simply fill in the coupon below, check the information you need, and mail.

G-B SNAP*ON® pipe insulation

Second to none in insulating efficiency among all general purpose pipe insulations is G-B SNAP*ON — the original one-piece pipe insulation molded of fine glass fibers. In one simple motion G-B SNAP*ON snaps over cold or hot lines up to 350°, indoors or out, to provide truly efficient and permanent thermal protection. Check **G-B SNAP*ON Brochure** in coupon below.

G-B ULTRALITE®
for duct wrap and lining

For life-long thermal efficiency, try ULTRALITE —the original insulation made of long, **strong** textile-type glass fibers. As a duct liner (right), ULTRALITE puts an end to objectionable cross-talk and air rush noises . . . never flakes off into the air stream. And its coefficient of friction is essentially the same as bare sheet metal. Uniformly thick ULTRALITE duct insulation (left) provides full insulating efficiency at rock-bottom costs. For further information, check **ULTRALITE Duct Liner & Insulation Brochure** in coupon below.



new "prefab"
glass fiber duct — G-B DUCT

G-B DUCT — the round, prefabricated duct made entirely of glass fiber insulation — absorbs cross-talk noises usually associated with air conditioning systems in motels, medical centers, retail stores, etc. G-B DUCT is high in thermal efficiency, too! Just check **G-B DUCT Brochure** in coupon at right for further information.

CHECK BROCHURE DESIRED

- ☐ G-B SNAP*ON BROCHURE
- ☐ ULTRALITE DUCT LINER & INSULATION BROCHURE
- ☐ G-B DUCT BROCHURE

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

GUSTIN-BACON Mfg. Co. gb

222 West 10th St., Kansas City, Mo.

Thermal and acoustical glass fiber insulations . . . Molded glass fiber pipe insulation . . . Couplings and fittings for plain and grooved end pipe.

Bethcon galvanized steel sheets permit long spans, minimum supports

Strong and rigid—because they're steel—Bethcon galvanized sheets form up into strong and rigid ductwork which requires a minimum number of supporting brackets.

In addition, a Bethcon galvanized steel sheet is just right for easy shopwork . . . not too hard, not too soft. That's because we use a special annealing cycle which gives the sheet an ideal balance of ductility and strength.

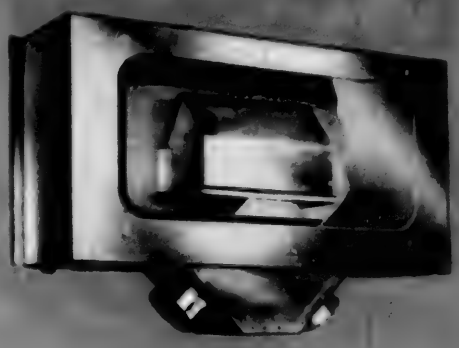
Bethcon's zinc coating is second to none for its refusal to flake or peel off. Bethlehem's continuous galvanizing process bonds zinc to steel so tightly that even when the sheet is doubled back on itself, the coating stays put. Hemming without puckering or wrinkling is no problem with Bethcon sheets.

You can specify Bethcon galvanized sheets in a wide variety of gages, with either plain open-hearth or copper-bearing (Beth-Cu-Loy) steel for the base metal. We'll be glad to furnish any details you need. Just get in touch with our nearest sales office.

for Strength
. . . Economy
. . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor Bethlehem Steel Export Corporation

BETHLEHEM STEEL



DUAL-DUCT...
UNOBTRUSIVELY EFFICIENT

The mark of fine air conditioning is its unobtrusive efficiency. It cools in summer, warms in winter, always maintains proper conditions...and there are no visible ducts or room units. This description fits Dual-Duct to the letter. Air mixing units, built by the pioneer and leader in high velocity air conditioning, may be concealed overhead in the ceiling or below windows. Volume is readily adjusted upon installation, or, if preferred, it may be pre-set at the factory to your specifications. Either way, there is never a balancing problem with Buensod Dual-Duct thanks to exclusive Automatic Volume Control which maintains constant air volume regardless of variance in static pressures. So whether your next installation is for a new structure or a renovation, make it a Buensod Dual-Duct installation.

BUENSOD DUAL-DUCT

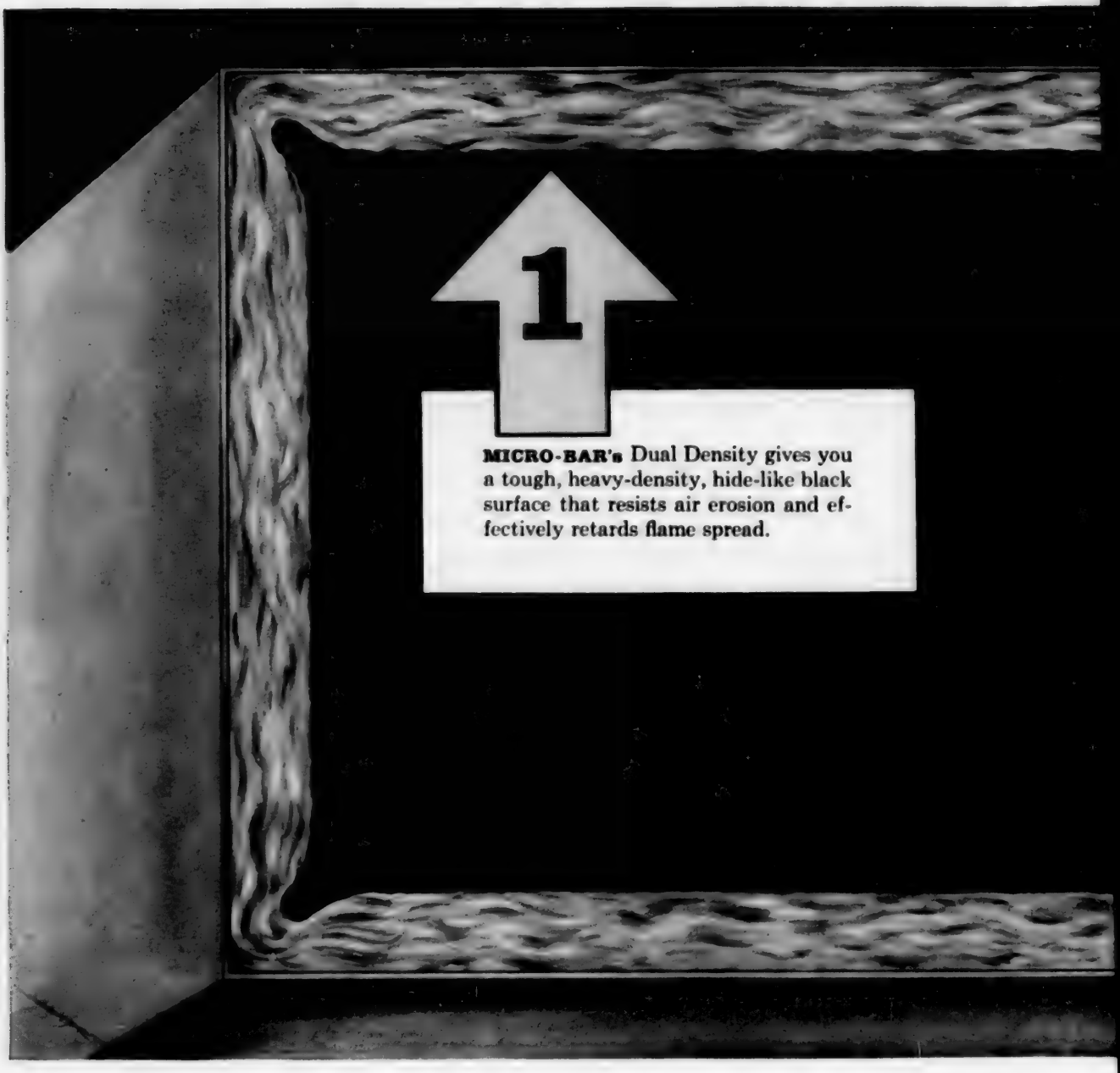
BUENSOD-STACEY CORP., 48 West 18th Street, New York 11, N. Y.

BUENSOD-STACEY

A subsidiary of Aeronca Manufacturing Corporation

"DUAL DENSITY"...

announcing an entirely new concept in fire-resistant and sound absorbent Fiber Glass duct liner from Johns-Manville


1
MICRO-BAR's Dual Density gives you a tough, heavy-density, hide-like black surface that resists air erosion and effectively retards flame spread.

J-M's NEW

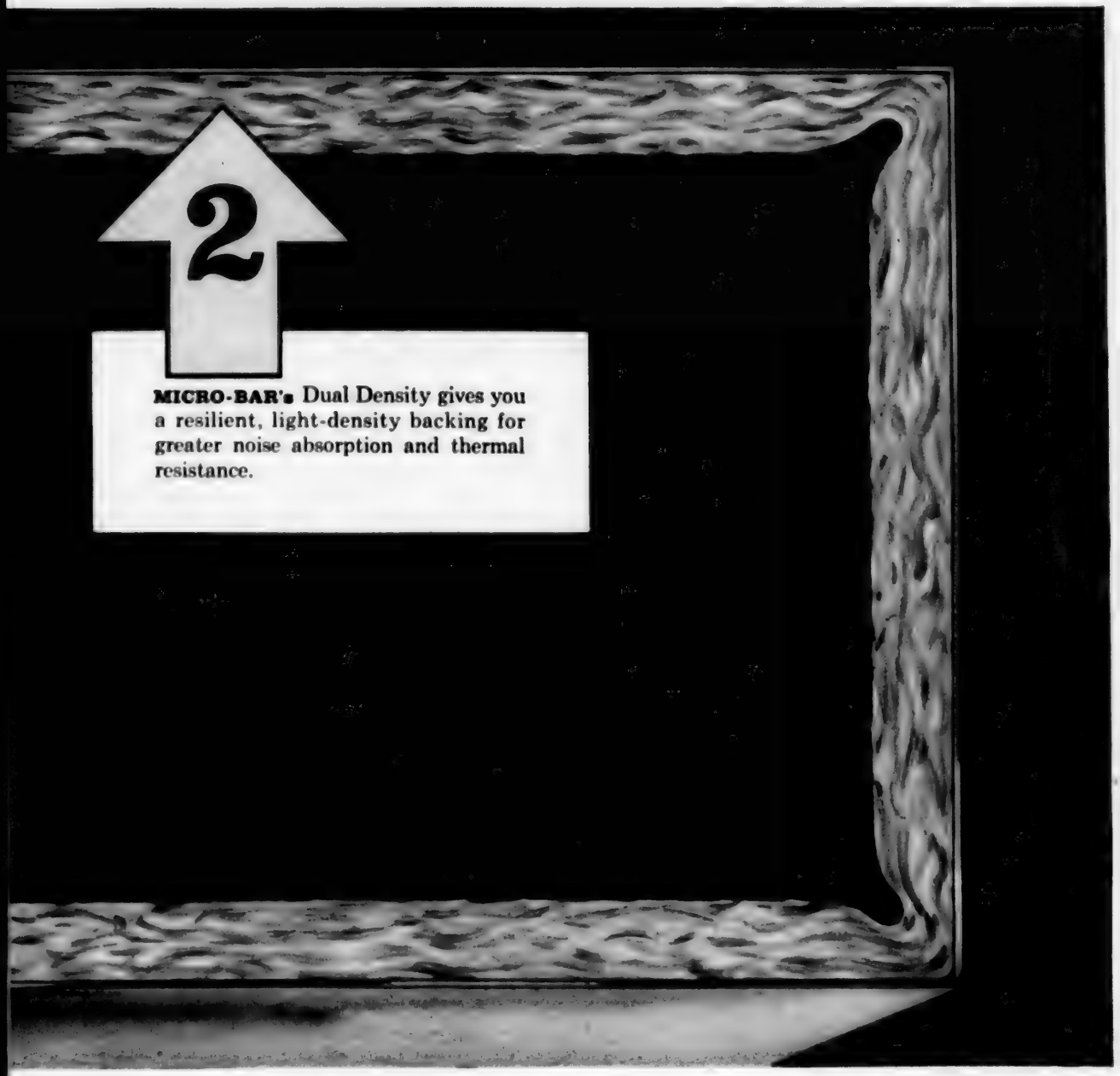
MICRO-BAR

GIVES YOU THESE IMPORTANT ADVANTAGES:

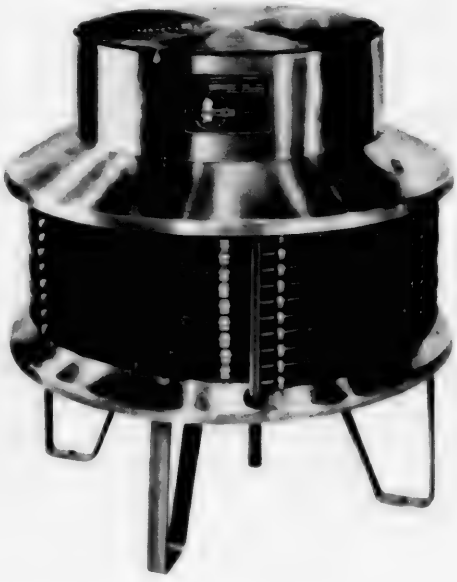
- *Extremely Low Fire Hazard Rating*
- *Tough Surface That Resists Air Erosion*
- *Exceptional Acoustical Performance*
- *Eliminates Need For Metal Nosings*
- *Greater Holding Power For Pins*
- *Easy To Apply By Conventional Methods*

Re Underwriters' Laboratories, Inc.®
INSPECTED
BATTS AND BLANKETS
Not Over 500 Sq. Ft. Issue No. F 141
FIRE HAZARD CLASSIFICATION (Based on 100 for untreated Red Oak)
Flame Spread 15 Fuel Contributed 25 Smoke Developed 5
L-3156 PRINTED IN U.S.A.

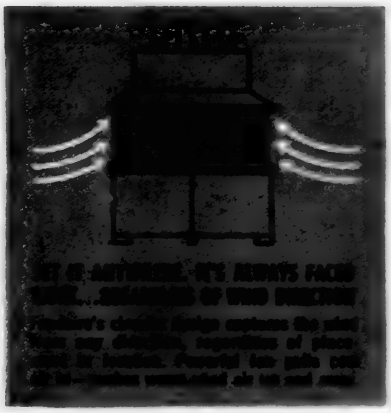
JOHNS-MANVILLE
FIBER GLASS


2
MICRO-BAR's Dual Density gives you a resilient, light-density backing for greater noise absorption and thermal resistance.

where a graceful silhouette makes a big difference



Circular Air-Cooled Condenser design blends with modern building needs



The new Fandaire offers more than architectural compatibility. It combines modern low silhouette lines with an exclusive high-heat dissipating fintube design. Unique in its efficiency, the entire circular spiral of fintubing is flooded with swiftly moving air from every direction, utilizing fully each degree of temperature drop.

Because the Fandaire weighs ⅓ less than conventional installations, it can be positioned where needed, without guy wires or extra bracing. *Savings in piping and installation alone can be considerable.* Fandaire is engineered in sizes from 3 to 120 tons – a model for practically all single or multiple installations. In terms of performance, these are the most economical air-cooled condensers available today. Easy to look at, too. Ask for complete information.

specialists in circular air-cooled condensers

YUBA-AIMCO DIVISION
801 West 21st Street, Tulsa, Oklahoma

YUBA CONSOLIDATED INDUSTRIES, INC.

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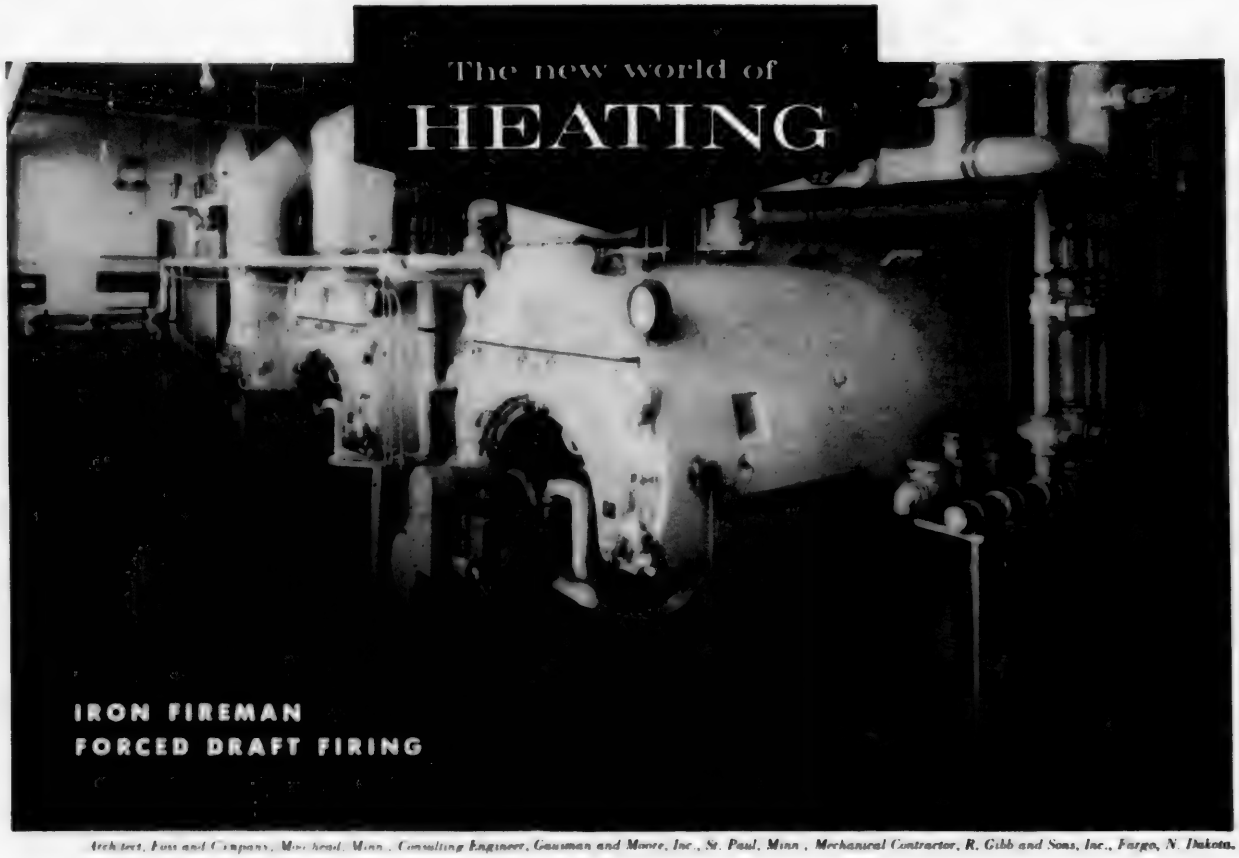
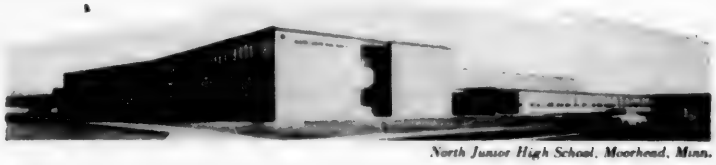


Architect, Foss and Company, Moorhead, Minn., Consulting Engineer, Gausman and Moore, Inc., St. Paul, Minn., Mechanical Contractor, R. Gibb and Sons, Inc., Fargo, N. Dakota.

NO STACK



North Junior High School, Moorhead, Minn.

Requires an exhaust vent only

Iron Fireman forced draft firing eliminates the need for a high stack, such as required for natural draft firing. This not only saves costly construction, but avoids the architectural disfigurement of a beautiful building.

Forced draft firing also has distinct advantages over an induced draft system. The latter operates in the high temperature exit gases at the boiler breeching, where gas volume has been enormously expanded by furnace heat requiring much greater fan capacity. Forced draft mechanism moves air at room temperature, with power savings as high as 50%. The electrical power consumption is reduced in proportion to the *volume, not* the *weight* of the air handled. It is quieter, more compact, more easily accessible and requires less maintenance.

Complete package, ready to go

Every factor that affects firing efficiency is engineered into the unit at the factory. Unit includes: (1) Oil, gas or dual-fuel burner. (2) Forced draft air supply. (3) Enclosed control panel (optional) with instruments mounted, factory wired and tested, and with signal lights and dials for a complete reading at a glance. Firing units are available with complete boiler-burner units, as shown here, requiring only service connections, or as a package burner suitable for any type of boiler.

Fires gas or low-cost residual oils, or both

Fires any type of fuel gas, or any grade of fuel oil from lightest to heaviest without burner adjustment. Available for gas, oil or dual-fuel firing with instant changeover. Simple capacity tables make them easy to size and specify.

Mail coupon for full information and specifications

IRON FIREMAN

HEATING AND AIR CONDITIONING
AIRCRAFT COMPONENTS AND EQUIPMENT
MISSILE AND AIRCRAFT GYROSCOPES
ELECTRONIC EQUIPMENT
CONTROL INSTRUMENTS

Iron Fireman Mfg. Co., 3087 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto)

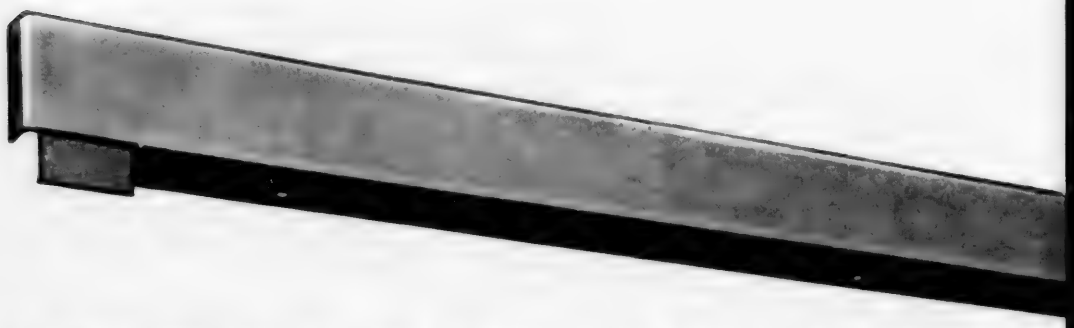
Please send complete technical description and specifications on Iron Fireman forced draft firing.

Name _____

Firm _____

Address _____

City _____ State or Prov. _____



PERMA-LAP® FRAMED MODINE CONVECTORS
EASIEST TO INSTALL, EASIEST ON THE WALL

PERMA-LAP framing assures a neat, permanent, recessed installation . . . units can be serviced without disturbing wall seal

Modine's PERMA-LAP framing ends all the problems common to recessed convectors of conventional design. With PERMA-LAP, Modine convectors install fast and clean . . . whether walls are smooth or rough. PERMA-LAP neatly frames the unit in the recess . . . snugs up to finished walls or can be plastered in. No chance for air leakage and resulting wall streaking.

Once Modine convectors are installed, walls are never disturbed. Servicing? Nothing to it! Machine screws permit rapid removal and replacement of the lighter-weight, smaller front panel . . . eliminate need for access doors.

Cost more? Yes, slightly more than conventional recessed convectors. But they actually save more than the difference in lower installation and redecorating costs.

PERMA-LAP is available for flush recessing and in 2⅜", 4⅜" and 6⅜" projections to permit partial recessing of convectors in walls of varying thicknesses. Modine's line of recessed cabinet units is also available with PERMA-LAP framing. For complete details, mail the coupon below. Or contact your Modine representative . . . he's listed in the yellow pages.

NO WALL STREAKING!

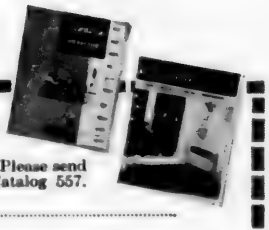
NO CRACKED PLASTER!

NO PEELED WALLPAPER!

NO "STARRED" CORNERS!

Modine®
MANUFACTURING COMPANY

In Canada: Sarco Canada, Ltd., Toronto 8, Ontario



MODINE MANUFACTURING COMPANY
1511 DeKoven Ave., Racine, Wisconsin

I would like complete PERMA-LAP details. Please send Convector Bulletin 259 and Cabinet Unit Catalog 557.

NAME.....

FIRM.....

ADDRESS.....

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R-1413

Made by ALCO
OF CAST IRON AND STEEL
like a Compressor
for LONG RELIABLE LIFE

4-WAY REVERSING VALVES
for all reverse cycle systems

Features:

- **fine machining and precision honing of cast iron slide and steel outer shell—** NO PLASTICS ARE USED.
- **operating tests of 300,000 cycles without failure to shift and without loss of tight seating—tests made by independent laboratories.**
- **shifting (change cycle) while the system is in operation with a 300 PSI differential.**
- **rapid shifting—to shorten change-over time and therefore shorten defrost cycle.**
- **the shifting of the valve independent of any pressure drops, and efficient shifting under any combination of operating conditions.**
- **mounting in any position—except with the pilot valve upside down.**

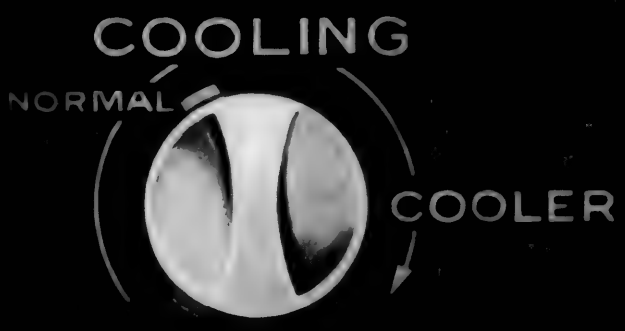
Call your Alco wholesaler—write for Specifications.

- *BUY SECURITY*
- *BUY QUALITY*
- *BUY ALCO*

8223

The one complete line of refrigerant controls: Thermostatic Expansion Valves • Refrigerant Distributors • Solenoid Valves Refrigerant Filter-Driers • Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves

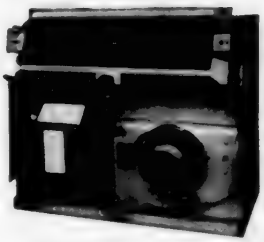
THE NEW CONCEPT IN HEATING AND COOLING



ELIMINATES THE COSTLY "CENTRAL SYSTEM"

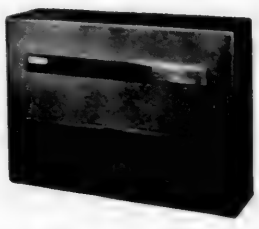
Other year-round air-conditioners *still* require elaborate central systems for the cooling cycle. Now, the new Warren Webster concept in heating and cooling obsoletes this costly installation: each Webster Newport is a *self-contained* unit for both heating *and* cooling. Comfort control is at your fingertips—day or night, summer or winter. Simply turn the knob of a Webster Newport for heating or cooling at *any* time, as varying comfort conditions require. Heat one room while you cool another . . . *every* room equipped with a Newport has its own individual system for year-round heating and cooling.

This modern way to air-condition saves you money right from the start. Attractive in-wall units can be economically installed a room at a time—*without* interruption of building occupancy. Webster Newports connect readily to existing heating systems—or a new all-electric model will tie in with electrical circuiting. An entire building can be air-conditioned in easy stages at savings up to 30% as compared to a central system installation. Let a Warren Webster man detail the savings—and convenience—*you* can look for with Webster Newport heating and cooling.



COOLING BY CHRYSLER AIRTEMP

EQUIPPED WITH CHRYSLER'S HEAVY-DUTY COMMERCIAL COOLING CHASSIS



WARREN WEBSTER & COMPANY, INC.

HEATING • COOLING

CAMDEN 5, NEW JERSEY

New Airfoil Bladed Fans exceed 90% efficiency

It's here now—a new line of Airfoil Bladed Fans from American-Standard Industrial Division . . . all carrying the AMCA certified rating seal! A completely new design, these Airfoil Bladed Fans employ a highly efficient, quiet fan configuration ideally suited for general ventilation and industrial process applications. High mechanical efficiency, over the entire fan selection range, means the lowest possible power requirements. Get the complete story. Send for Bulletin A-1103 today. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Ltd., Toronto, Ontario.

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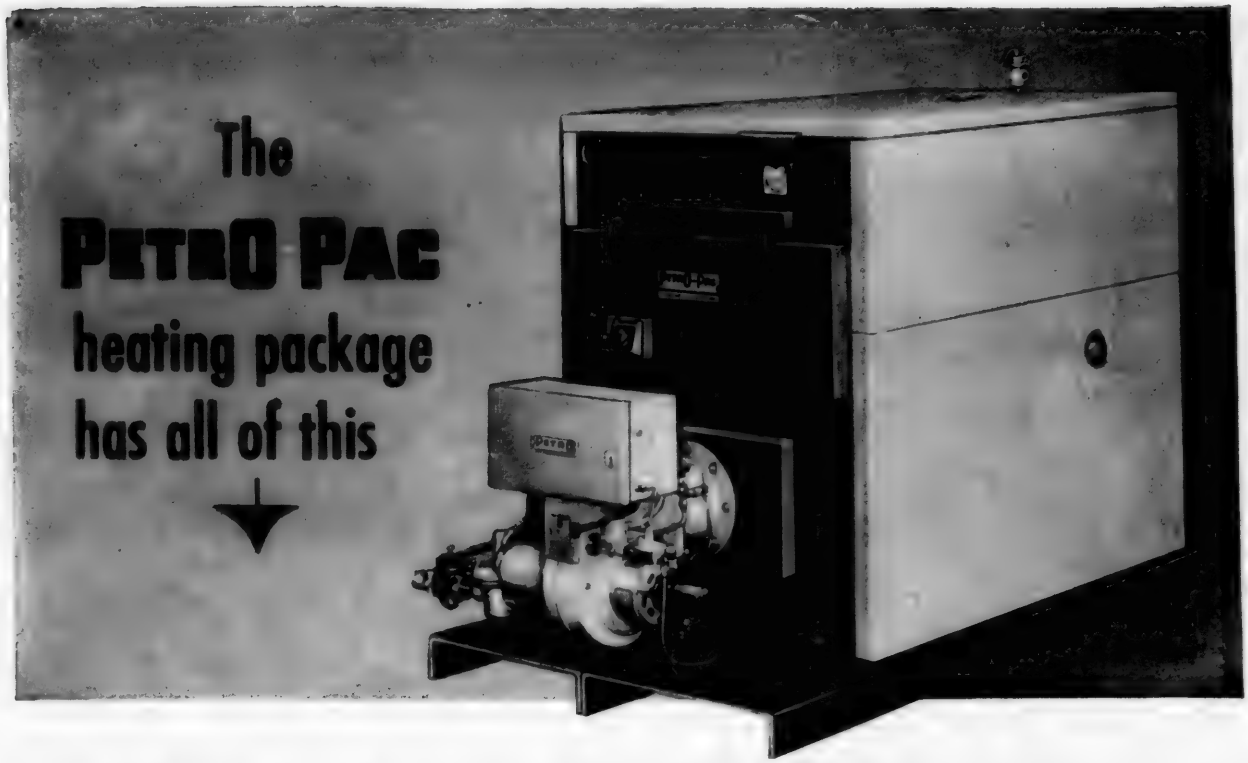


No base—low water line
Elimination of the boiler base required by the conventional square boiler reduces the height as much as 24 inches—in some cases much more. This leaves ample room for overhead piping even when ceiling height is limited. No pitting necessary.

Exhaust vent only—no stack needed
Forced draft firing is completely free of all natural draft problems. Exhaust vent can be as much as one third smaller than usual flue diameter, and no higher than is necessary to discharge combustion products away from buildings. No draft regulator needed (except with an excessively high stack).

Outstanding fuel economy—low standby loss
The Petro combustion system quickly achieves complete combustion even in a cold firebox. Heat absorption begins immediately. No delay while refractory comes up to temperature. No stored heat lost in refractory after burner stops. Sealed combustion reduces flow of heated air from furnace to vent during "off" periods.

Clean exhaust—no flame pulsation
Industry standards tolerate smoke during a 15 minute warmup. The Petro Pac produces a clean flame within seconds. This prevents air pollution and sharply cuts service costs, most of which are due to fouled combustion controls and sooted flues. Flame is steady—no pulsation. No hot surface is needed to "support combustion."

For gas, oil or dual-fuel firing
Petro Pac single fuel models are available for forced draft firing of either gas or oil. Dual-fuel models are especially desirable in areas where oil equipment is required as a standby for gas firing. Quick changeover is accomplished by a fuel selection switch.

Easy installation
Spot it where you want it; make service connections. No special skill required to install or operate. Petro Pac leaves the factory as a packaged unit. Fuel system, air system and operating controls are built in, factory wired and tested.

PETRO
TM. REG. U.S. PAT. OFF.
MAKERS OF QUALITY
HEATING AND POWER EQUIPMENT SINCE 1903

PETRO
3219 West 106th Street, Cleveland 11, Ohio
(In Canada: 80 Ward Street, Toronto, Ontario)
Please send me literature and specifications on the Petro Pac packaged boiler.

Name _____

Company _____

Address _____

City _____ Zone _____ State or Prov. _____

Johnson Control Systems Are Backed by the Largest and Most Experienced Service Force in the Control Industry

Efficient temperature control will be just as essential in your clients' buildings in 5, 10, 20, or more years as it is today.

That's a key reason to specify Johnson Pneumatic Control Systems, for it is traditional Johnson policy that *future service is as important to owner satisfaction as the original sale.*

That is why Johnson maintains the largest and finest service organization in its field. Full-time, factory-trained service mechanics are stationed in hundreds of cities across the nation. These maintenance and repair experts make it easy for every client to keep his Johnson Temperature or Air-Conditioning Control System operating at peak efficiency throughout the life of his building.

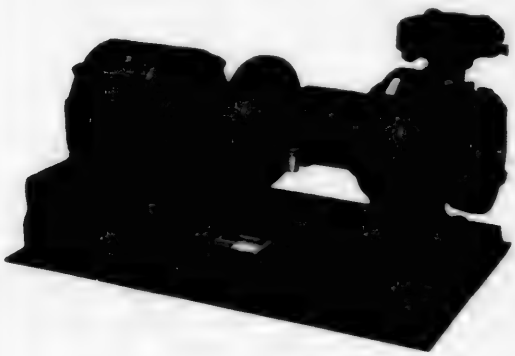
With a Johnson Pneumatic Control System, your clients avoid the annoying delays, guesswork, and inflated costs of depending on non-specialists for service.

Unmatched service is just one of many advantages you and your clients get with Johnson Control. Your local Johnson representative will be glad to supply full details. Johnson Service Company, Milwaukee 1, Wisconsin.

How the REMITE® seal in

B&G® centrifugal pumps

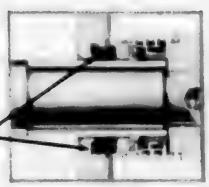
assures leak-proof operation



A new material, called "Remite," developed in the Research Laboratory of the Bell & Gossett Company, simplifies the problem of keeping water out of the bearings of centrifugal pumps.

"Remite" is almost diamond-hard...easily cuts glass... corrosion-resistant as well as wear-proof. In all B&G Universal and industrial pumps it is used as a floating seat facing a carbon seal. This unique combination eliminates pump leakage and gives trouble-free service even when the pumped liquid contains foreign material.

"Remite" is also produced commercially for a wide variety of applications where hardness and wearing qualities are important. It has high flexural strength and is resistant to chemical attack and high temperatures. Electrical insulating properties are good at both high and low frequencies.



Position of "Remite" Seal as used in B&G Universal Pump—a unit noted for quiet operation.

BELL & GOSSETT
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Dept. GG-4, Morton Grove, Ill.

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ont.

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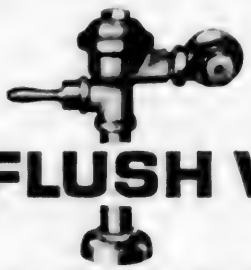
You pay no more for unequalled SLOAN quality...

More *than just a diaphragm!*

• Research is constantly employed at Sloan finding ways to make our Flush Valves better. The Segment Diaphragm is one result. This diaphragm costs a lot more to make, but we know it is a superior product which adds to that bonus of quality you expect from Sloan.

• Called the A-56-A, it is made of natural rubber vulcanized with brass reinforcements. Rubber? Yes, we've found it best by far. Rubber is actually preserved by water—not deteriorated by it—and the flexing action prolongs its life.

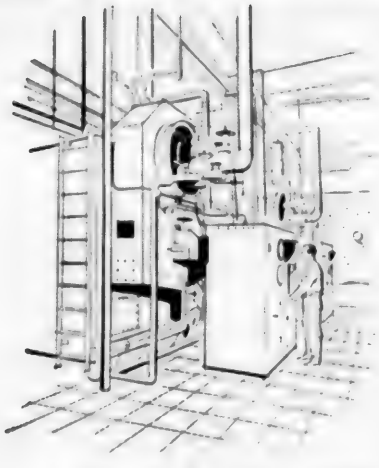
• Not all the improvements we adopt from research make our headlines, but the Flush Valves we make today are better than ever. We know they've got to be to merit the continued confidence of those who specify, select and install them. And since you can have Sloan quality at no extra cost—why not make sure you get it.



SLOAN FLUSH VALVES

SLOAN VALVE COMPANY • 4300 WEST LAKE STREET • CHICAGO 24, ILLINOIS

First B&W Shop-Assembled Boiler Ever Built Starts Life #2 South of The Border...



Number 1 of Nearly 1,000 Similar Units Meets Expanding Steam Requirements of Mexican Textile Firm

A decade ago, a major cleaning and laundering concern in Staten Island, N. Y., needed a dependable supply of steam for their massive laundering operation. In filling that need, B&W designed and delivered its first shop-assembled boiler. Operating at 165 psi and 358 F, this oil-fired package boiler served the company to perfection with 20,000 lb of clean, dry steam per hour.

The Staten Island firm had continuing success with this new departure in boiler design and in less than two years, the unit had paid for itself. The recent advent of the automatic washer and dryer, however, had so changed the laundry business that the firm now finds itself predominantly a dry-cleaning establishment. Having no further need for a unit as large as the FM-type boiler, the original owner recently sold it (at a good percentage of its original cost) to another B&W customer, the Textiles y Acabades Company of Mexico. Today, the boiler continues its fine record, generating heat and process steam for the Mexican textile firm.

Indicative of the *built-in* durability of B&W units, the "times and travels of FM-1" are further evidence in action of dependable steam generation by B&W. Whatever *your* steam requirement . . . whatever your most economical fuel, B&W has the boiler best suited to your application. Your local B&W representative has all the facts on your area. Call him soon. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W — THE NATION'S LEADING MANUFACTURER OF INDUSTRIAL BOILERS

G-980-1B

B&W

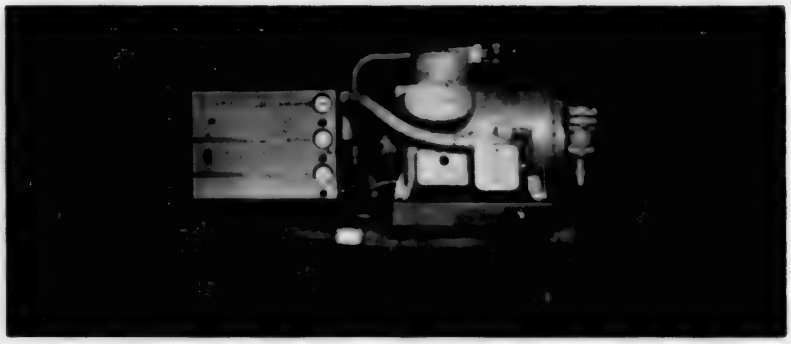
THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

3 NEW DEVELOPMENTS FROM CARRIER!

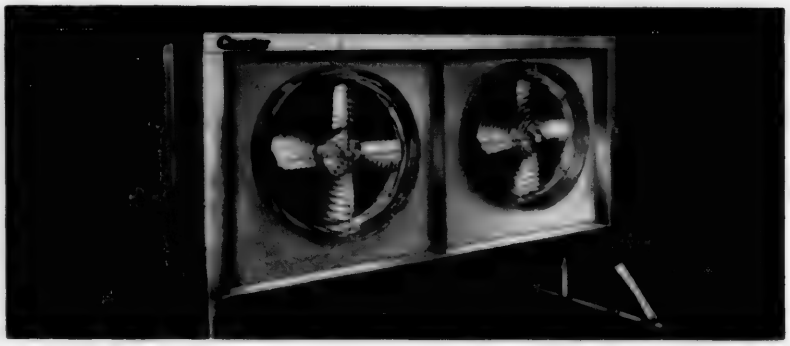
6G AND L HERMETIC CONDENSING UNITS

With the development of the 6L80-83-85, Carrier now offers a complete line of hermetic condensing units with refrigeration capacities from 10 to 145 tons for both air conditioning and refrigeration installations. The 6G and L units, entirely factory assembled and wired, consist of a compressor, motor, water-cooled condenser, safety controls and motor starting and protection equipment. If desired, they can be ordered in models without a water-cooled condenser.



9AB AIR-COOLED CONDENSERS

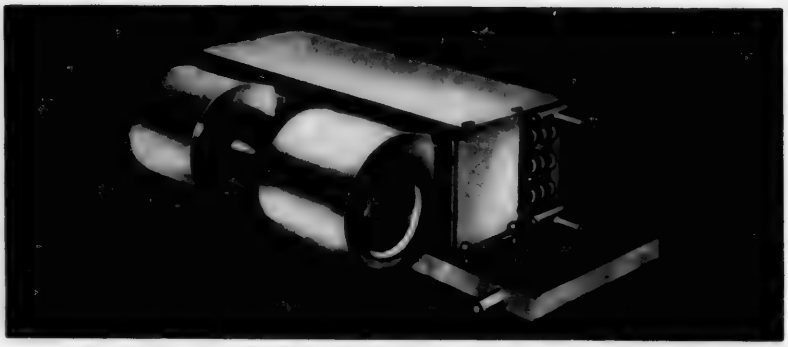
Skillfully engineered, laboratory tested, the new Carrier 15-ton condenser can be mounted on the roof vertically for an extremely low silhouette — or horizontally. Powerful direct drive fans move large quantities of air evenly across the entire surface of the coil—a factor that increases the efficiency by utilizing the full condenser capacity. Other Carrier air-cooled condenser units are available with horizontal discharge in three capacities—5 tons, 7½ tons and 10 tons.



36W FAN AND COIL WEATHERMAKERS

This portion of Carrier's extensive line of fan and coil Weathermakers* with a single piping system will provide individual control of cooling and heating for multi-room buildings. This versatile unit is for overhead type of installation. It can be concealed or mounted in-the-space with an available metal cabinet. A complete line of control packages can be used to meet the most difficult specifications. The unit comes in 4 capacities: 200, 300, 400 and 600 cfms.

**Reg. U.S. Pat. Off.*



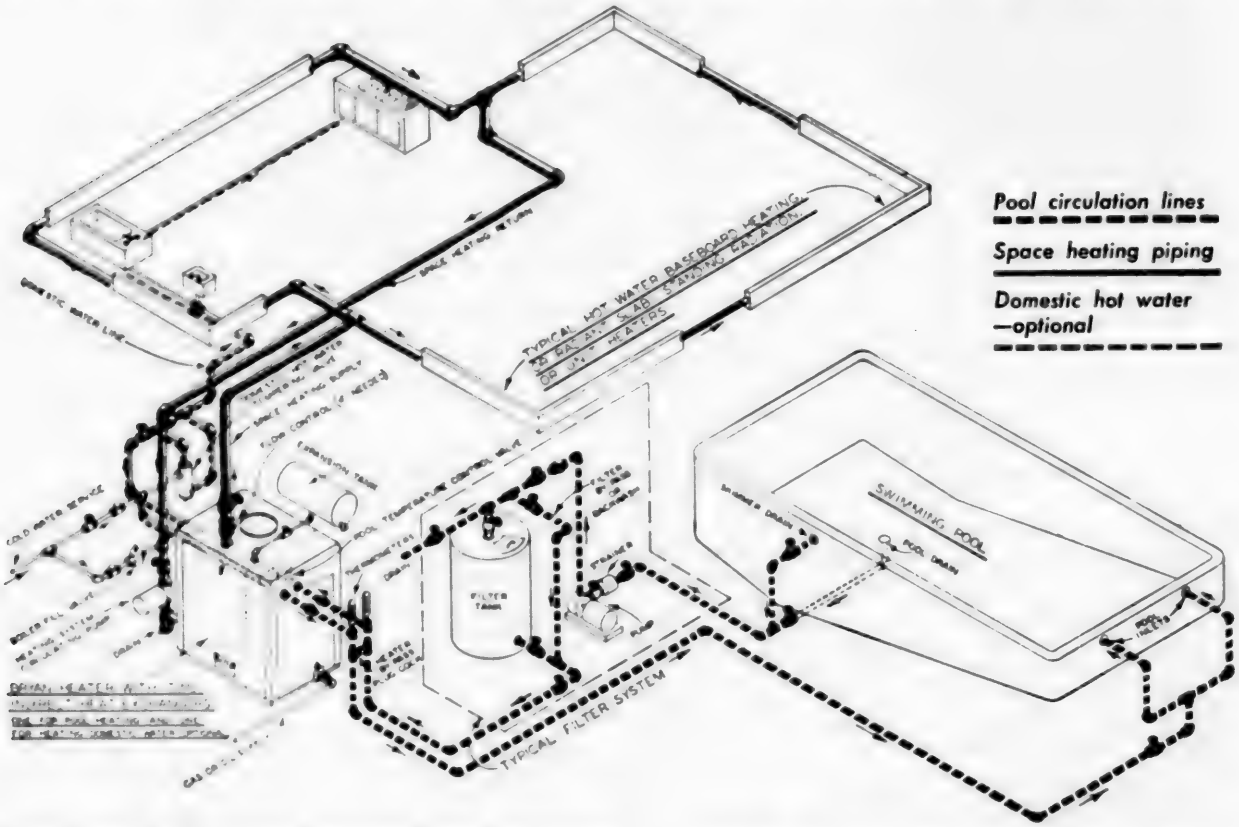
For complete details about these new products, see the Carrier dealer listed in the Yellow Pages. Or write Carrier Corporation, Syracuse 1, New York.

BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

Carrier

hot water FOR | POOL HEATING SPACE HEATING DOMESTIC SUPPLY

in this typical multi-purpose water heating system

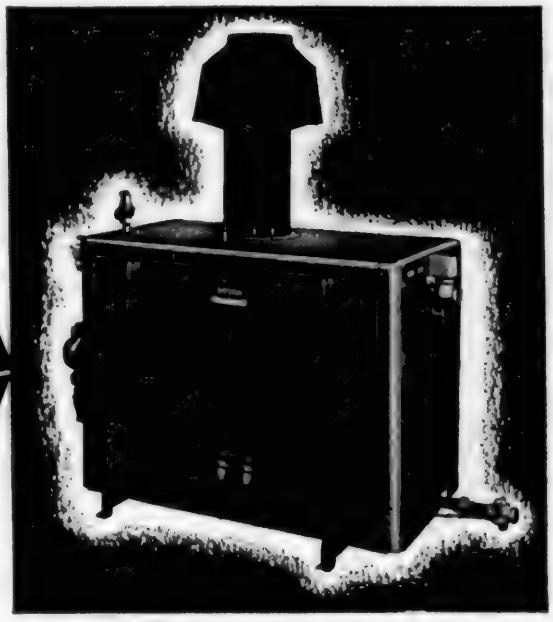

Pool circulation lines
Space heating piping
Domestic hot water —optional
TYPICAL HOT WATER BASEBOARD HEATING OR UNIT HEATERS OR RADIANT SLAB HEATING INSTALLATION
SWIMMING POOL
POOL DRAIN
FILTER TANK
TYPICAL FILTER SYSTEM

Note how the BRYAN separate heat exchangers furnish hot water at desired temperatures for Pool Heating, Space Heating, and Domestic Hot Water (optional). The BRYAN indirect heat-exchanger method minimizes scale formation and corrosion, assures efficient, economical operation.

Gas or Oil fired models available in applicable sizes from 125,000 b.t.u. to 2,250,000 b.t.u. input.

Bryan Copper Tube boilers are designed and built to the requirements of the A.S.M.E. Code. Gas-fired models A.G.A. approved.

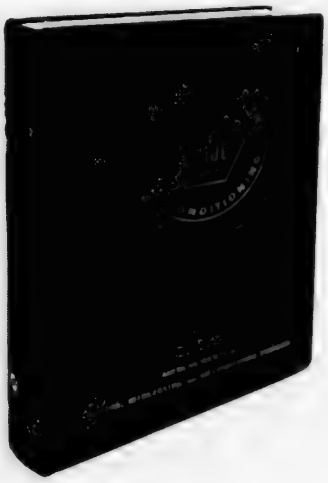
BRYAN *Copper Tube* **BOILERS**



For further information, write or phone

BRYAN STEAM CORP.
Peru, Indiana

NEED RELIABLE, UP-TO-DATE TECHNICAL DATA?



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THE

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The GUIDE 1960 is your most complete source of all the latest important technical information, current practices, and product developments in air conditioning, heating, ventilating . . . the basic reference book of the profession . . . prepared by experts . . . a valuable addition to every company reference library.

The outstanding improvements in this edition include (1) a rewritten chapter on thermodynamics, (2) extensive revision in sound control chapter, (3) new data on restaurant hot water requirements and method of sizing equipment, (4) a new section dealing with fundamentals, detection and elimination of odors, (5) extension of winter design temperatures to Alaskan cities, (6) new data on equivalent duct lengths for sheet metal fittings, (7) additional information on pipe and tube heat gain and loss, (8) a new chart and table for selection of chimney sizes for automatically fired boilers, (9) revised data on water treatment, (10) maximum allowable concentration of air contaminants adjusted to values adopted by the ACGIH in 1959, (11) new illustrations of automatic control arrangements for air-conditioning systems, (12) a rewritten chapter on residential air conditioning, (13) revised rating data for steel boilers, packaged units, and furnaces, (14) new data on operating controls for oil burners, and (15) a new table of gas piping flow capacities.

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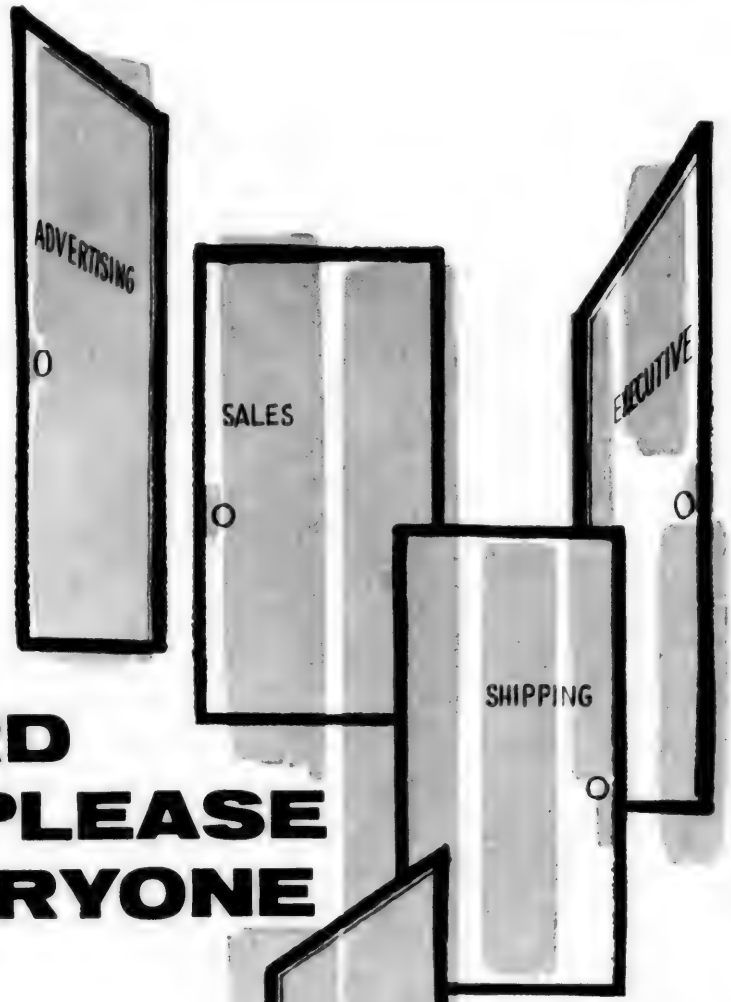

IT'S HARD TO PLEASE EVERYONE

- - - BUT *Buffalo Zone Conditioning Comes Awfully Close!*

From one central cabinet here's individual year 'round comfort conditioning to suit **many** different areas of a building. Each zone is controlled automatically. Consider these exclusive ***Buffalo*** features:

RUGGED TUBULAR FRAME — easily assembled and installed. Convenient to service thru handy access doors, removable panels and outside bearings.

CHOICE OF COMBINATIONS — floor or suspended mounting arrangements — any combination of heating, cooling or humidity control.

LOW HEAD ROOM due to 45° pitched coils.

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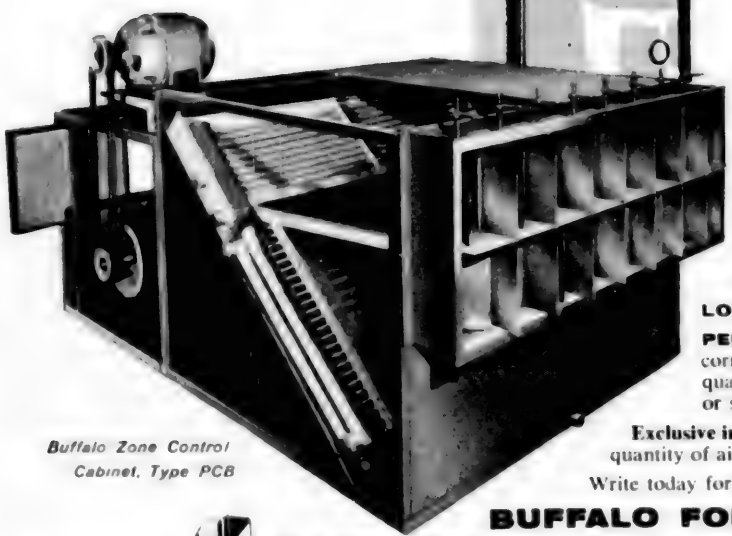
Exclusive individually sized damper zones to accurately proportion quantity of air flow.



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Buffalo air handling equipment to move, heat, cool, dehumidify and clean air and other gases

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...seam it

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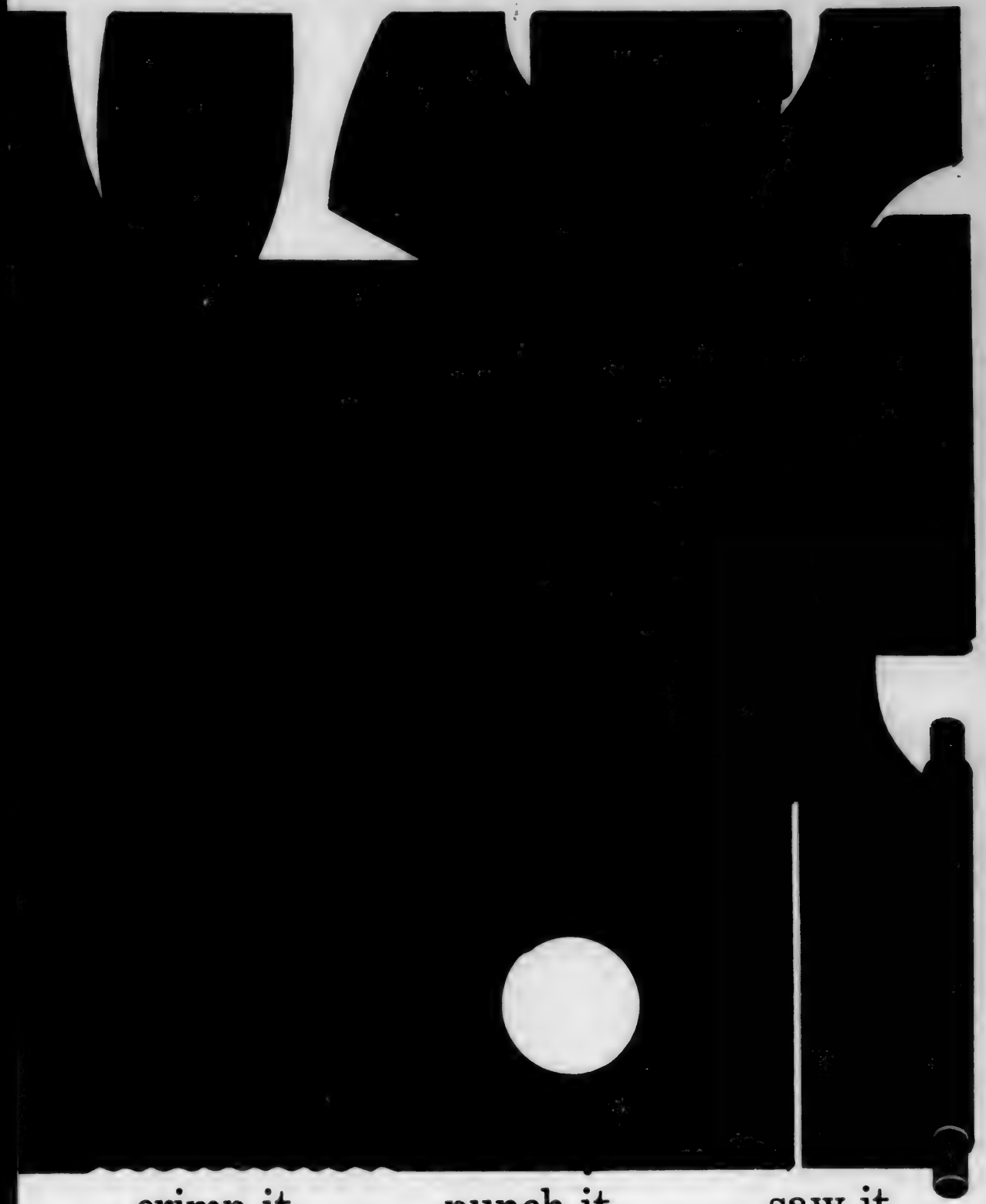

...lock it

...wire it

...crimp it ...punch it ...saw it

The MARSH way is the SURE way—

You'll have a new conception of how *uniformly good* radiator valves, traps and vents can perform when you make the job Marsh all the way through.

Take the Radiator Valve and Trap illustrated here, for instance:

The Marsh Radiator Valve is *truly* packless—not just *called* packless. This valve has no "packing" whatever... instead, the ingenious Marsh annular mechanical seal that keeps it drip tight throughout its far longer life.

And Marsh Radiator Traps are equally sure-footed... have the famous Marsh Diaphragm—extremely rugged, but so sensitive that it never fails to close tight on steam, yet opens instantly to pass condensate and air at only a few degrees below closing temperature.

Yes, the Marsh way is the sure way... Valves, Traps, Vents, F & T Traps, designed, built and tested to give lasting satisfaction in the Marsh tradition. Ask for up-to-date Heating Specialties Catalog 76-H.

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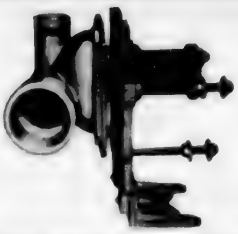
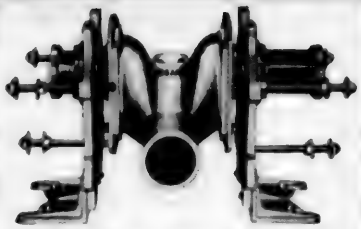


No. C-720-W Single Horizontal UNITRON Closet Fitting and Carrier



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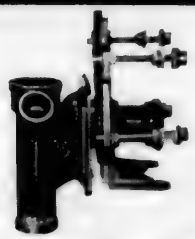
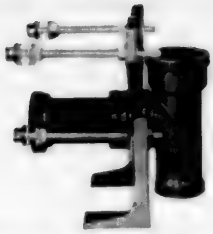
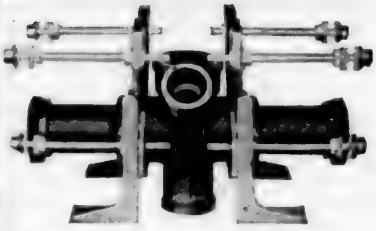


No. 835-W Single Vertical UNITRON Closet Fitting and Carrier



No. C-858-W Single "Close" Vertical UNITRON Closet Fitting and Carrier



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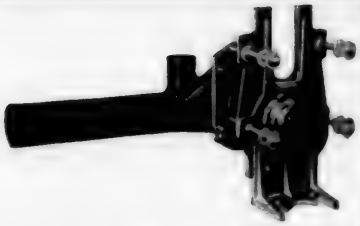
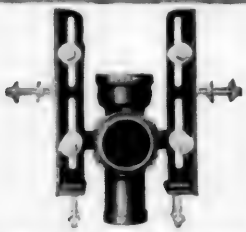


No. C-745-W Long Barrel Single UNITRON Closet Fitting and Carrier



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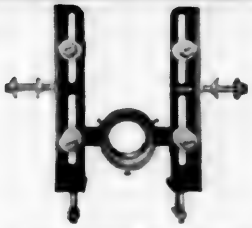

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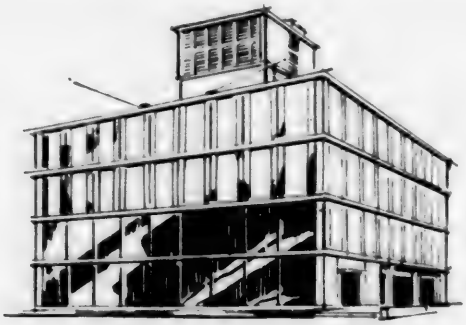

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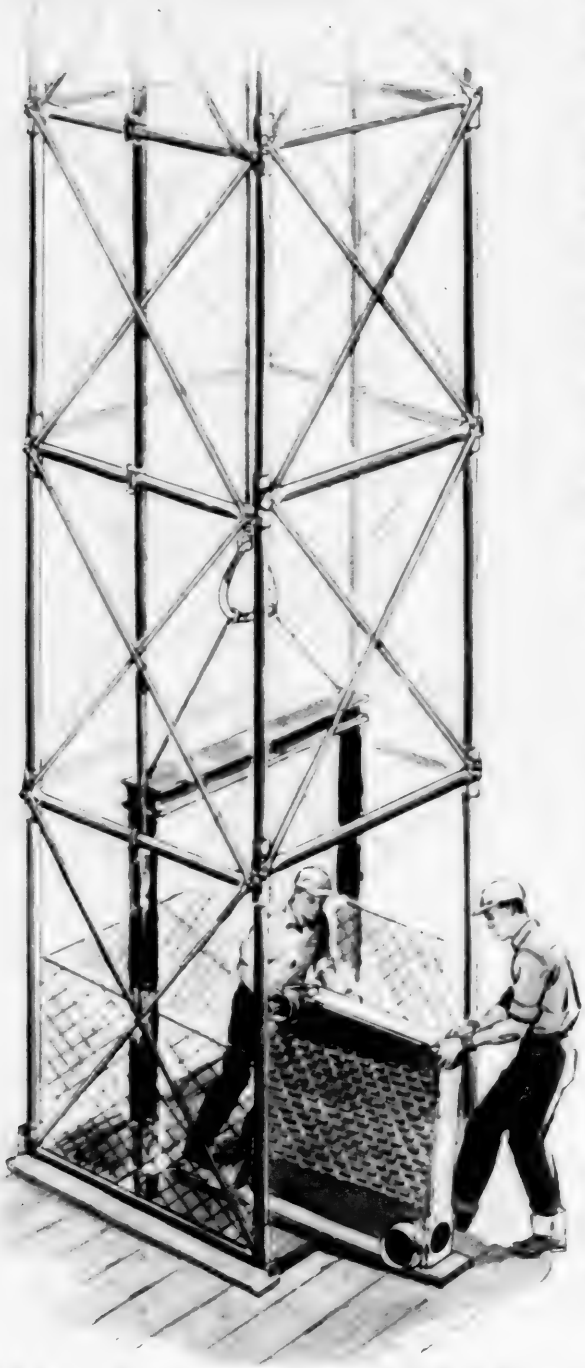

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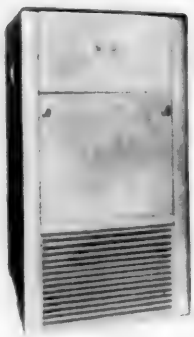

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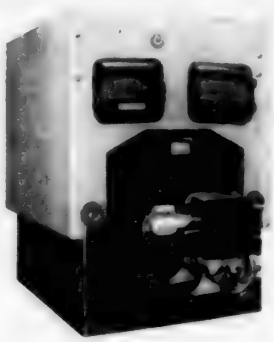

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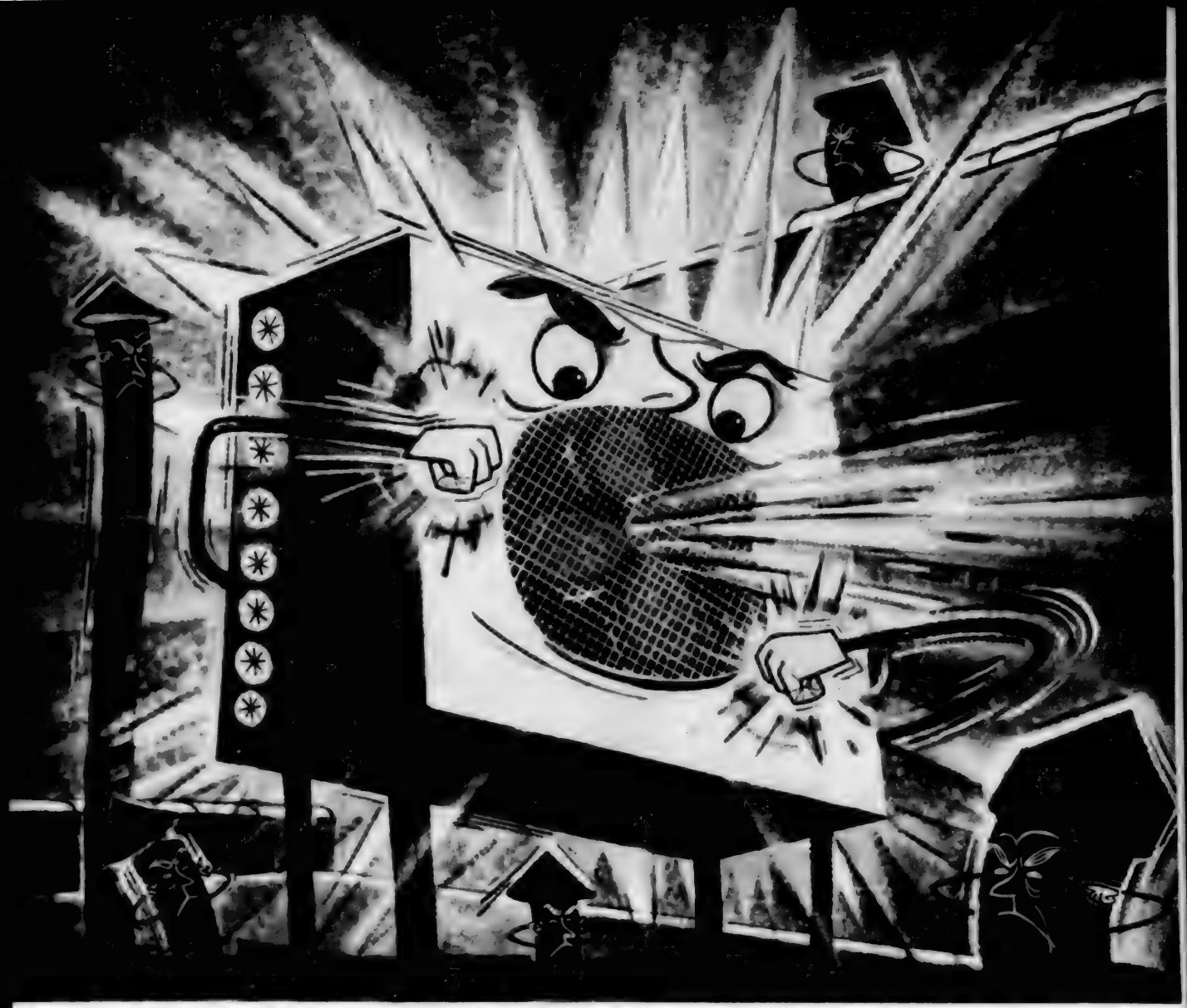

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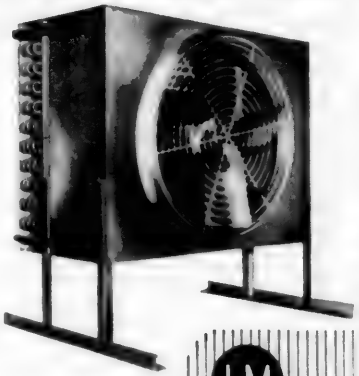

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Today's Operating Problems
Aid Tomorrow's Design.
A Case in Point—

Mechanical Shaft Seals

DR. SIDNEY SUSSMAN
Water Service Laboratories
New York, N. Y.

- **Mechanical shaft seals incorporate two rings which have contact faces at right angles to a pump shaft. One ring is fastened through its assembly to the shaft and revolves with it, while the other is stationary and is held against the pump casing.**
- **Mechanical shaft seals overcome many problems encountered with jam-type packing. These problems can include wearing of the pump shaft, increased power requirement to rotate shaft, and leakage from shaft run-out and end play.**
- **Mechanical shaft seals, however, can and do have their own difficulties and it is the purpose of this article to present their limitations and to pinpoint sources of trouble, so that today's operating problems can aid tomorrow's design — of equipment and of systems.**

WITHIN THE EASTERN AREA bounded by Connecticut and Virginia, the water problems which develop in urban cooling and heating systems derive largely from two factors:

1. The generally soft, low alkalinity water supplies, and
2. The relatively high degree of air pollution.

In open spray systems, such as cooling towers, the combination of these two factors results in the development of strongly acid, untreated circulating waters. These severely corrosive conditions (pH ranging from 7 to as low as 2.5) frequently result in the corrosion of copper from condenser tubes and other copper-containing equipment, and the subsequent plating out of the dissolved copper on ferrous metal parts, such as cast iron pump housings.

Although conditions in closed chilled water systems or hot water heating systems are rarely as severe as those in open systems, corrosion is hardly the nonexistent or negligible consideration which many engineers believe it to be in closed systems. This is due largely to the fact that the term "closed" is relative. Such systems show the effects of water losses from various sources, and the extent of replacement water needed is often surprisingly large. With the introduc-

tion of additional makeup water comes additional dissolved oxygen making the water more corrosive.

Circulating pumps in such closed systems can corrode rather rapidly. The steel impeller from one hot water heating pump which had been in service for only nine months seized because of an accumulation of corrosion products, and was found to have been completely perforated in several places. A yellow brass impeller, which had pumped untreated hot water from Philadelphia's Schuylkill Supply for only one year and ten months, was almost completely dezincified, and could be broken into small pieces by hand.

The severely corrosive action of such waters can be controlled quite well by properly administered chemical treatment and good maintenance practices. This subject has been discussed extensively, and we will only mention here that such corrosion control includes bringing the pH up to the 7-8.5 range and the maintenance of a pre-determined concentration of a corrosion inhibitor in the circulating water. The most universally effective corrosion inhibitor now in use is sodium chromate. Under field conditions this program can effect a reduction of better than 90% in the corrosion rate.

Over much of the country harder, more alkaline makeup waters prevail so that the primary water problem in cooling systems is scale formation, rather than corrosion. The techniques and chemicals used for controlling scale are not particularly effective in controlling corrosion.

Mechanical Shaft Seals

Having established the propriety of water treatment to prevent corrosion damage in both open spray and closed circulating systems, the author would now like to turn to mechanical shaft seal-equipped pumps used on cooling and heating systems. These pumps generally utilize mass-produced seals equipped with ceramic and graphite (carbon) contact rings, as shown in photo at heading of article and in Fig. 1.

It is very difficult to get accurate data on the performance of mechanical shaft seals in such systems, as, indeed, it is for any other component of the systems, because of a lack of uniformity in reporting experiences and a lack of common standards for evaluating performance. Procedures used for the preparation of new systems before regular use differ from one job to another, operations in different systems vary, and criteria used for determining whether performance is acceptable also differ. Difficulties which cause the personnel to reach for the panic button in one installation are considered normal maintenance problems in another. Nevertheless, it will be of some value to review a number of case histories.

Open Spray Systems

The performance of mechanical shaft seals on air conditioning systems (mostly below 500 tons cooling capacity) in the previously defined area has varied, but more often than not it has been poor. We have heard of installations which have had five or more years of satisfactory experience with mechanical shaft seals, whereas others have had repeated failures within a period of months. One Philadelphia building, for example, operated for five years with satisfactory performance of mechanically sealed pumps circulating a chromate-treated water. After some leakage began to develop, the mechanical seals were replaced. The replacements suffered two successive failures within a single year.

Successive seal failures at intervals of a month or less are not uncommon in such systems. One telephone company division in the New York metropolitan area has had so many maintenance problems resulting from repeated failures of mechanical seals on pumps in open spray systems, that they have stopped using such seals on this service. Such experiences are apparently not unique since we have received a letter from one pump manufacturer which stated:

> "It has been our experience that the use of mechanical seals on air conditioning systems is always somewhat of a risk."

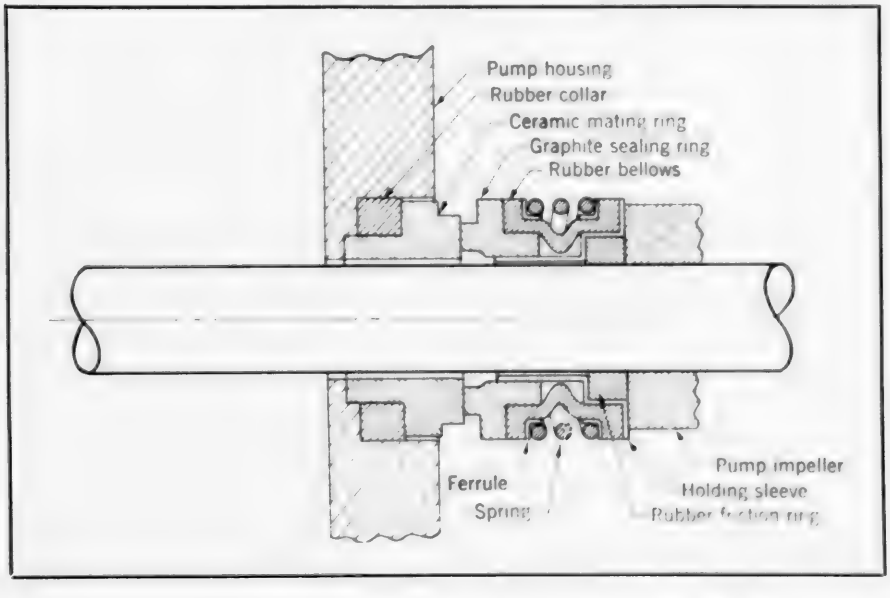

Fig. 1. Sectional view shows a typical, mass-produced, rotary type mechanical seal mounted in place on a pump shaft. Mating ring is held stationary in pump housing and sealing ring, on liquid side of the pump housing, rotates with its assembly on the pump shaft.

and another pump manufacturer expressed this opinion:

> "The reason we bring up the physical properties of the liquid is that the mechanical rotary seals are designed for operation with clear liquids only, free of any abrasive or foreign matter. Such materials in solution will immediately damage the sealing faces on the mechanical seals with resultant leakage. For installations where the liquids contain abrasives or foreign materials, it is strongly suggested that the standard stuffing box type gland be used."

To our knowledge, at least two pump manufacturers who previously offered mechanically sealed pumps for cooling water and related services, now either offer packed pumps only, or offer a choice of mechanically sealed or packed pumps. Several consulting engineers have also informed us that unhappy experiences with mechanically sealed pumps have led them to specify only pumps equipped with packing glands for cooling tower service.

Closed Circulating Systems

Our experience with the use of mechanically sealed pumps has been erratic in both hot water heating and combined cooling and heating systems, too. With both treated and untreated circulting waters we have had reports of trouble-free service on the one hand and of frequent failures on the other. With combined cooling and heating systems, mechanical seal troubles frequently develop when shifting from cooling to heating. This suggests that there is a temperature effect involved, possibly resulting from the known reduction in the lubricating properties of water at higher temperatures. The frequently observed tendency of the graphite wearing ring to adhere to the ceramic ring may result from this effect.

Causes of Seal Failures

Various sources have ascribed mechanical seal failures in cooling and heating systems to a limited number of causes:

1. Mechanical abrasion resulting from loss of lubrication as the result of too high operating temperatures;
2. Mechanical abrasion resulting from solid particles entering between the bearing surfaces;
3. Mechanical abrasion resulting from mis-alignment; and
4. Chemical deterioration of the bearing surfaces resulting from attack by treatment chemicals.

Failures resulting from excessively high temperature are really failures to specify the proper equipment, rather than an inherent failure of the seal itself. They should be readily identified by comparison of the operating conditions with the seal manufacturer's specifications for use limits. In one hot water heating system the seals which failed were offered for service up to 180 deg F, but the system operated at 200-220 deg much of the time.

An occasional hot water heating system can develop sub-atmospheric pressures at the pump suction. Mechanical seals will lose their lubrication and fail under such conditions unless special arrangements have been made to provide lubrication by introducing water from a suitable source.

Dr. Sidney Sussman is chief chemist for Water Service Laboratories. He received his B.S. in Chemistry from Polytechnic Institute of Brooklyn in 1934, and a Ph.D. from Massachusetts Institute of Technology in 1937. Before joining his present employer in 1949, he served with DuPont Co., The Permutit Co., and Liquid Conditioning Corp. With many articles and patents to his credit, plus a War Department citation for a seawater desalting development, he is a member of eight professional societies.

One pump manufacturer and a seal manufacturer have told us that most standard mass-produced mechanical seals are not suitable for long service at temperatures above 180 deg. They estimated an average life of one year for such seals under these conditions, but stated that they have seen failures in as little as two months.

In our experience, all other mechanical seal failures that we have observed resulted from mechanical abrasion, caused either by mis-alignment of the seals or by foreign particles getting between the bearing surfaces.

In urban areas, open spray systems scrub a good deal of dirt particles from the air. These include organic matter, fly ash, sand particles, or materials peculiar to local industry, such as hair fibers in the fur district of New York City. Many of these solid particles are quite abrasive and do a considerable amount of damage to pump shafts and shaft seals. This is a purely mechanical action which is not controllable by the presence or absence of water treatment chemicals.

In closed systems, similar abrasion can develop as a result of construction debris circulating with the water if the system has not been properly cleaned before being placed in service. It can also develop as a result of fine particles of mill scale which break away from the black iron piping.

Each time we have had an opportunity to examine a seal after failure, microscopic examination has shown that the graphite sealing ring was badly scored. In most cases, as illustrated by Fig. 2, it was completely unnecessary to use a microscope to observe this.

Typical illustrations of seal failures by abrasion include one which developed leaks after seven months of service on a cooling tower system in southern New Jersey. Suspended matter was present in the water. In a hot water heating system inspection of a seal which failed by scoring showed the presence of numerous tiny particles of mill scale in the water and on the seal. In a combined cooling and heating system in Atlantic City, New Jersey, the abrasion was so severe that the raised wearing surface on the graphite ring was not only worn down to the shoulder, but the abrasion continued wearing the graphite down to the point where contact was made with the brass holder. This is shown in Fig. 3.

Some of these hot water heating systems contain strainers for removal of solid particles. In many cases, the particles which can work their way between the

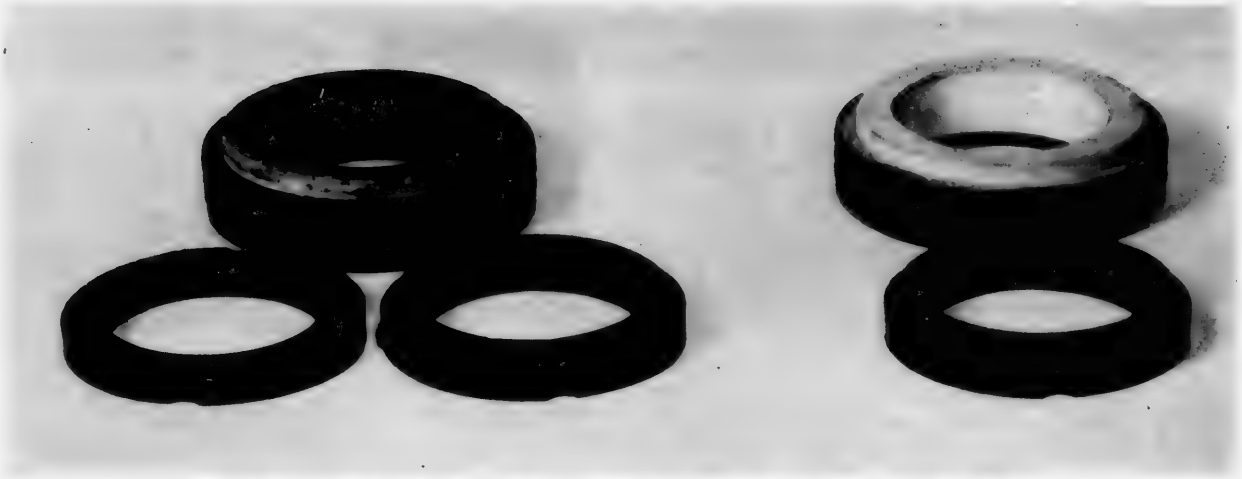

Fig. 2. Shown at left are typical graphite and ceramic rings which have failed. Note scoring of contact surfaces on two used graphite rings, at left front, and dark coating of graphite on used ceramic ring, at left rear. Unused rings are shown at the right.

bearing surfaces of mechanical seals are too small to be retained by the strainers. One operating engineer eliminated his mechanical shaft seal failures by wrapping the bronze strainer with a series of permanent magnets. These retained mill scale particles on the inside of the strainer regardless of their particle size. Periodic cleaning of the strainer enabled him to reduce seal failures to negligible proportions within a relatively short time.

Mis-alignment may be a primary or a contributory cause of seal failure. We have seen one failure from angular mis-alignment in which the contact surface of the graphite ring was worn down to the shoulder at one point, but was still $\frac{1}{16}$-inch high at the diametrically opposite point, as shown in Fig. 4.

The chilled water circulating pump for a large Philadelphia office building suffered mechanical seal failures every few weeks during the first year of operation. The water was not treated and the system had not been cleaned after construction. At the end of the first year, inspection showed that the shaft had corroded, and it was felt that uneven distribution of corrosion products had led to mis-alignment of the shaft seal. The shaft was undercut and equipped with a stainless steel sleeve which effectively halted further corrosion at this location. The new mechanical seal installed with the stainless steel sleeve then operated for two years with no further leakage. This took place in spite of the fact that opening of the chiller at the end of the second year showed the presence of substantial amounts of mill scale, gravel, weld splatter, and other construction debris, some of which had been circulating through the system since it started operation.

Although mis-alignment was the apparent cause of seal failures in this case, operation with foreign suspended matter in the circulating water, particularly in a new system, normally results in short life for mechanical seals. This is recognized by seal manufacturers. For example, in a bulletin dated October, 1959, one manufacturer of mechanical shaft seals frequently used for cooling and heating systems states:

> "In a new plant or building system, it should become a recognized duty of the consulting engineer to specify seals specifically designed for

Fig. 3. Severe abrasion of ring at right in photo wore away the graphite contact surface below level of shoulder. A new graphite ring assembly is shown at left for comparison.

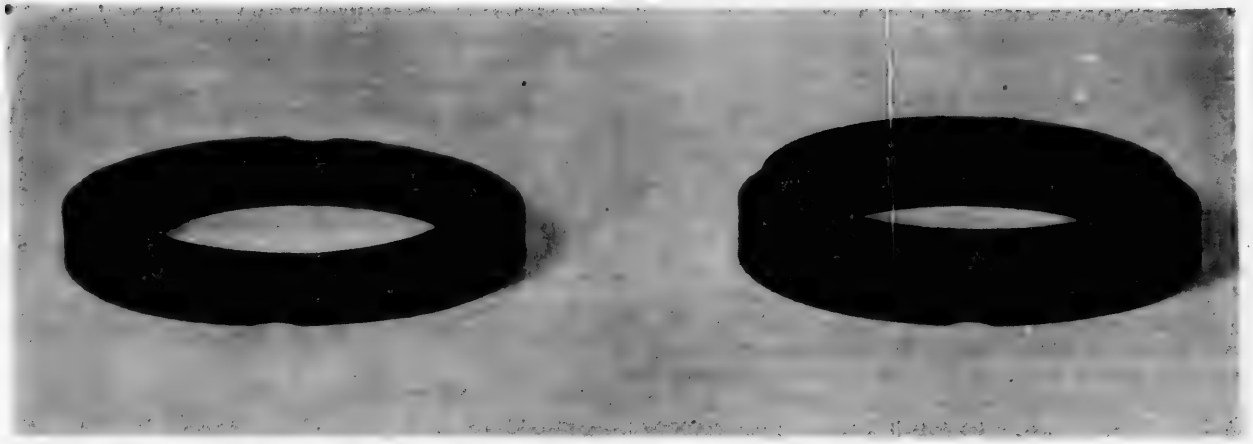

Fig. 4. Worn and scored graphite ring on left shows effect of angular misalignment. Note residue of raised contact surface remaining on left side although ring is worn flush with shoulder on right side. A new graphite ring is shown at right.

each service condition, and to further specify two (2) additional sets of wearing parts to be furnished with all mechanically sealed equipment. Because of pipe scale, welding scrap, dirt, etc., which are inherent to a new piping system, provisions should actually be specified to accommodate these conditions."

With regard to high temperature conditions, this same bulletin states:

"Since the mechanical seal is being successfully used on many power plant boiler feed pumps, there is no question about its ability to handle high temperature, high pressure water. However, the mechanical seals are successful on these applications because proper provision is made for cooling the water in the seal chamber and, most important, the water is practically free of impurities.

"If the same conditions could be obtained in the commercial hot water systems, there would be very little trouble with mechanical seals on these applications.

"If the above mentioned conditions cannot for some reason be met, the pumps should be equipped with packing and provisions be made to take care of some leakage which is necessary for satisfactory operation of packing. It must be remembered, however, that the same conditions of high temperature without cooling and abrasive particles in the system will require constant attention to packing and, frequently, the replacement of shaft sleeves."

Unfortunately, statements such as the above are not as widely circulated to consulting engineers and contractors—perhaps even to pump manufacturers—as they should be.

Whether the problem is failure of a mechanical shaft seal, failure of other parts in contact with treated water, or operating difficulties, the water chemist is well acquainted with the statement: "It is the fault of the water treatment chemical". It is not, therefore, surprising that this same cry has been raised frequently when mechanical shaft seals have developed leaks.

In our own laboratories we have carried out numerous static and dynamic tests of the effects on mechanical seal components (graphite rings, ceramic rings, rubber, and brass parts) of water containing the more common water treatment chemicals at both normal and excessively high concentrations, and at normal and high pH values. None of these tests has given evidence of inter-action between chemical seal parts and treatment chemicals. Several manufacturers of pumps and of seals have also indicated that treated water has no effect upon their products. One manufacturer of pumps which include mechanical seals has written to us:

"We have found that the usual treatment has little or no effect on the life expectancy of the pump seal."

This same manufacturer indicated that water used for testing his pumps was treated with the same chromates used in corrosion control treatment of air conditioning cooling waters.

Our Philadelphia Laboratory recently carried out a series of short term dynamic tests using rotating, loaded mechanical seals immersed in waters of varied composition. When the ceramic and graphite rings of test seals were carefully aligned, there was no evidence of damage with seals operating in tap water or in treated waters containing even 2500 parts per million (ppm) or more of sodium chromate, and with pH values up to 10 and above. However, if the two contact rings were permitted to be out of alignment by 1/16 inch or even less, the water in the test vessel rapidly clouded with bits of graphite and the graphite ring was scored after a short test run even in plain tap water.

Recently, dynamic tests of longer duration by one of the mechanical seal manufacturers suggested that the particular graphite and ceramic seals produced by this company may have a tendency to deteriorate rapidly when in contact with higher chromate concentrations under operating conditions, although they found no apparent effect under static conditions. On the basis of their preliminary tests, recommendations have been made that chromate concentrations be limited to 250 ppm or below in systems in which pumps

are equipped with these mechanical seals.

Our experiences with systems equipped with seals of this manufacture are not consistent with the findings of these preliminary tests.

For example, in one large hospital, repeated leaks developed in mechanical seals of three closed circulating cooling and heating systems shortly after chromate treatment was started. Because of incorrect system volume estimates, the chromate concentrations in these systems were on the order of several thousand ppm. To avoid further difficulty when the seals were replaced, each system was to be drained and re-filled with untreated water. No further leaks developed on resuming operation, but investigation showed that only two of the systems had been drained. The third system, no longer leaking with a new seal, still contained 1190 ppm of sodium chromate and had a pH of 11.

In another large metropolitan hospital three pumps equipped with these seals were installed. When leaks developed on the two chromate-treated systems, the treatment chemical was immediately blamed as the cause of the leaks. Investigation disclosed that seals on the third pump, being used for the *untreated* water supply, were also leaking just as badly. When a new building was installed at this same hospital, a cooling tower and chilled water system were treated by the building staff using a proprietary non-chromate chemical which, according to the mechanical contractor, would not affect the mechanical seals. Within a matter of weeks, the seals on both of these pumps were leaking badly.

On the other hand, we know of one installation in Hempstead, N. Y., at which repeated mechanical seal leaks stopped suddenly when chromate treatment of the cooling tower water was started. We believe that this situation resulted from the simultaneous cleaning of the system and more careful alignment of the new seal installed when chromate treatment was started, but the contractor insists that the chromate treatment *stopped* leakage of the shaft seals.

However, even should further tests confirm that there is an effect of chromate-treated water upon the carbon rings of these or other mechanical seals, there appears to us to be both practical objections to and a fundamental fallacy in attempting to overcome this difficulty by limiting the chromate concentration which may be used in the circulating water.

From the practical viewpoint, the close control of water treatment necessary to insure both a maximum of 250 ppm of chromate and the minimum of about 200 ppm required to properly protect the equipment in an open spray system is almost impossible to attain under normal operating conditions, particularly in non-industrial establishments. Further, not only does a 250 ppm chromate maximum reduce the factor of safety for protection of the equipment almost to the vanishing point for cooling water systems, but it is well below the recommended average of 1000 ppm necessary to control corrosion in hot systems.

Fundamentally, however, there is a greater objection to limiting the concentration of water treatment chemical in order to protect the mechanical seals. The operator of a water system is being asked to jeopardize an investment of many thousands of dollars worth of piping and equipment because the use of a mechanical seal on the circulating pump limits the concentration of corrosion inhibitor which he can place in the circulating water. The obviously more prudent handling of the situation from his viewpoint is to replace the relatively inexpensive shaft seals with other seals or with packing glands which will perform satisfactorily under his operating conditions. To limit the concentration of necessary water treatment chemicals in a cooling or heating system in order to protect the carbon ring on a pump shaft seal is like attempting to wag a large dog by his tail.

Handling the Mechanical Seal Problem

It appears to us that the difficulties experienced with mass-produced mechanical seals on pumps used in many cooling and heating systems derive from economic questions. Mechanical shaft seals can be made for satisfactory performance under almost any type of service conditions—high temperatures, corrosive environment, abrasive solids. However, such specialized seals are more expensive than the type discussed in this paper. This suggests that the ultimate solution to the mechanical seal problems described will be research by seal manufacturers leading to the development of relatively inexpensive, mass-produced mechanical seals made of materials which are resistant to abrasion, and which will perform effectively despite the presence of any chemical likely to be used for water treatment and in concentration ranges likely to be encountered under practical, not ideal, operating conditions.

Until such improved seals are available, the working solution to the mechanical seal problem would seem to be more precise specifications for the operating conditions under which present seals will perform satisfactorily, realistic recognition of their limitations, and better education of the various users—consulting engineers, contractors, pump manufacturers, and operators—with regard to these limitations and to the importance of proper application, operation and maintenance.

Various mechanical improvements can be made to assist good operation in existing systems with shaft seals. The magnet-wrapped strainer described earlier is one such. On some pumps the mechanical seal is lubricated by a line drawing water from the discharge side of the casing. With waters carrying or likely to carry abrasive solids, use of a strainer on this line has been suggested to minimize seal damage. For systems which require makeup water, a small proportion of clean, untreated makeup water can be introduced at the cavity containing the mechanical seal at a pressure high enough so that the lubricating water flows inward toward the pump.

By working together on the intelligent selection of the shaft sealing mechanism for each specific job and on the correct operation and maintenance of the system, seal and pump manufacturers, consulting engineers, contractors and water treatment specialists can avoid predictable or preventable mechanical seal failures and, more important, keep their customers and clients happier.

Can you safely select

Electronic Temperature Controls For Surgical Suites?

Yes, states the author, a medical doctor specializing in anesthesiology, and an outstanding authority on the prevention of explosion and fire in the operating room. He is past president of Pennsylvania Society of Anesthesiologists and twice has received its distinguished service award. He has been chairman for eight years of the Committees on Standardization of Anesthesia Equipment and on Hospital Hazards for the American Society of Anesthesiologists, and in 1956 received the International Anesthesia Research Society Award. He is professor of surgery and chairman of the section on anesthesiology of the University of Pittsburgh School of Medicine; also Director, Department of Anesthesia, St. Francis General and Medical Center Hospitals, Pittsburgh, Pa. This is his background; following are his reasons for his affirmative position.

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AUTOMATIC temperature control systems can represent twenty percent or more of the cost of the mechanical system to which they are applied. In the past it has been the position of some engineers that these systems should be of the pneumatic type because of the explosion hazards associated with operating rooms.

The validity of this position can be determined by an analysis of the explosion hazards inherent in an operating room and the relationship of the hazards to the functioning and malfunctioning of an electronic temperature and humidity control system.

The three essential factors required for the development of an explosion are as follows:

1. *Combustible gases or vapors.* In ordinary anesthesia practice, the gases or vapors are ethylene, cyclopropane, diethyl ether, and divinyl ether, or a combination of these. We must not exclude the nitrous oxide-oxygen-ether sequence, because this mixture is also flammable.

2. *Oxygen supply.* Oxygen is essential to all ordinary combustion. In anesthesia, oxygen is supplied pure, diluted in air, or in chemical combination with nitrogen in nitrous oxide.

3. *Ignition source.* Flammable mixtures require an ignition source for an explosion to occur. Ignition sources may be small flames, incandescent surfaces, local combustion initiated by catalysts, and electric sparks.

Factors one and two are essential to practical anesthesia. However, the third factor, the ignition source, is not essential and should be controlled or eliminated if fires and explosions are to be controlled. See Table 1.

If electronic systems can be utilized, they offer potential savings by stimulating competitive bidding in a field that does not seem to be overly competitive. For older buildings, the electronic systems which draw power from existing electrical lines seem to have an advantage over the pneumatic systems which are forced to install an air compressor plus air piping to remote equipment.

The use of remote control centers for temperature and humidity adjustment has many advantages; as shown in Fig. 1, electronic controls are readily adaptable to this type of system. The control center is located in the air conditioning equipment room, away from the surgical suite, and serves as a nerve center for the entire control system.

The precision of the electronic sensing, plus the advantage of positive positioning of the controller through feedback circuits, insures quality in the control performance. These potential advantages warranted an investigation of the relative safety of electronic control systems.

Electronic temperature and humidity sensing devices are spools of wire. The temperature sensing device undergoes a change in resistance in direct proportion to a change in temperature. The humidity sensing device is immersed in a moisture sensitive, non-organic substance so that its resistance is an inverse function of humidity change.

Most electronic control circuits employ the Wheatstone bridge principle. The sensing device is one leg of the bridge circuit. As the resistance in this leg changes, a current flow is initiated. The resulting voltage change is reflected by the bridge. This voltage is amplified and operates a phase sensitive relay that starts corrective action at the controller. A potentiometer circuit in the controller feeds a varying voltage back to the opposite leg

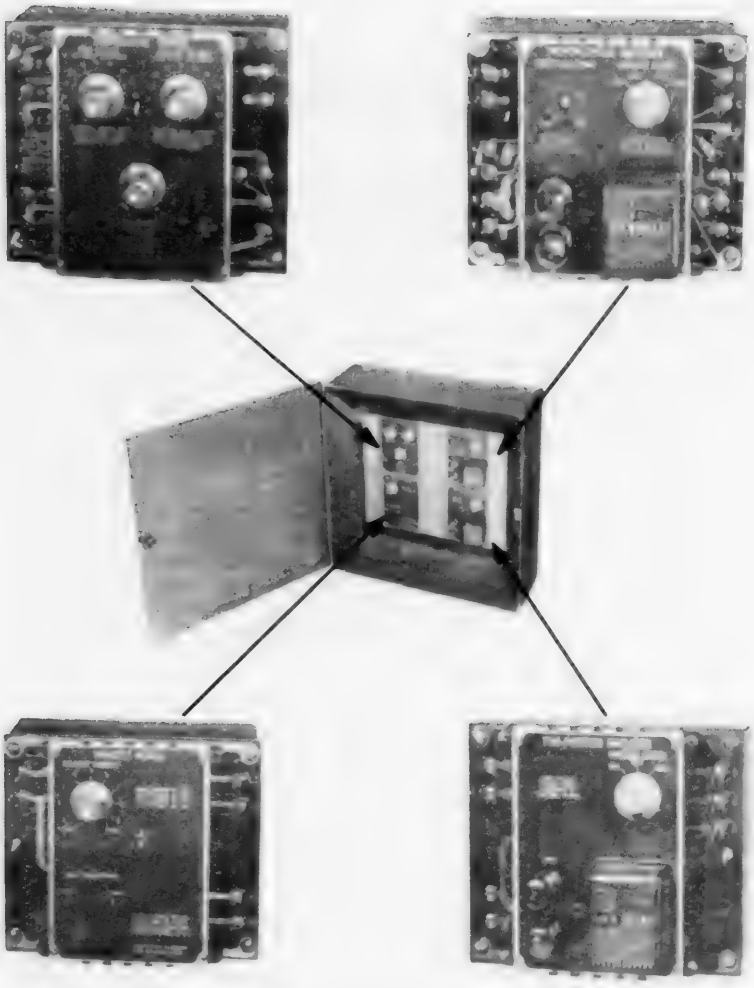

Fig. 1. Modular electronic bridges and amplifiers are assembled in pre-wired control centers for simplified installation. Remote location of such control centers insures that only low-voltage electronic sensing elements will be located within the surgical suite.

of the bridge circuit, as determined by the position of the controller, to restore bridge balance. At the balance, or null point, the system is at rest.

An analysis of electronic control equipment supplied for testing by one manufacturer* revealed the following operating characteristics:

The temperature sensing device has a normal operating voltage of 6.3 volts and a current flow of 6.3 milliamperes. The transformer supplying voltage to the bridge circuit has a 115 volt primary and a 12.6 volt secondary. Over-current devices are added to the secondary circuit. If 220 volts are inadvertently wired to the transformer, it will burn out, rendering the system inoperative.

* Barber-Colman Co., Rockford, Ill.

TABLE I—LIMITS OF FLAMMABILITY OF ANESTHETICS[1]

Anesthetic Agents	Density (Density of air taken as 1)	Limits of Flammability, Percentage by Volume					
		In Air		In Oxygen		In Nitrous Oxide	
		Lower	Upper	Lower	Upper	Lower	Upper
Ethylene	0.97	3.05	28.6	2.90	79.9	1.90	40.2
Propylene	1.45	2.00*	11.1	2.10	52.8	1.45	28.8
Cyclopropane ..	1.45	2.40	10.3	2.48	60.0	1.60	30.3
Ethyl Chloride ..	2.23	4.00	14.8	4.05	67.2	2.10	32.8
Ether-divinyl ...	2.42	1.70*	27.0*	1.85	85.5	1.40	24.8
Ether-diethyl ...	2.56	1.85*	36.5*	2.10	82.0	1.50	24.2
Nitrous Oxide .	1.52	Not Flammable		Not Flammable		Not Flammable	
Chloroform	4.12	Not Flammable		Not Flammable		Not Flammable	

[1] Jones, G. W.; Kennedy, R. E.; Thomas, G. J.; Technical Paper 653, Bureau of Mines, 1943.
* Tests made in 8 liter, cylindrical, closed steel bomb.

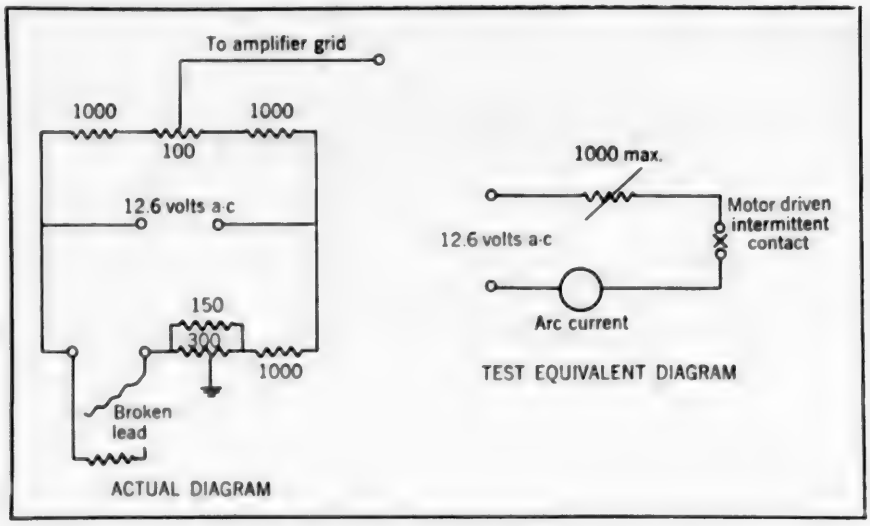

Fig. 2. Connection diagram used in testing electronic sensing element when used in an operating room under a hypothetical hazardous condition.

To simulate the most hazardous conditions of malfunctioning, the room element was completely shorted at the room location; then the short was opened in an attempt to produce arcing. This procedure first caused the current in the short circuit to go to 12 milliamperes, and then as the short was broken the voltage across the potential arc increased to 12 volts. The maximum arc power was .144 watts. It is a very remote possibility that such a sequence as the element being completely shorted out and then the circuit opening at the element would happen. But it is the only way that maximum power in the bridge circuit could be applied to an arc at the element. See Fig. 2.

Normal operation allows 6 milliamperes to flow in the element. If the element breaks, causing an open circuit, the maximum power in an arc would be .072 watts. This is probably the only real type of failure that would happen on an installation. In the case of the adjustable room element, there is a possibility of arcing at the slide wire. Here, too, the maximum arc could only be caused by completely breaking the connection of the slider and the wire, causing an arc of .072 watts.

The possibility of an arc, caused by normal operation of sliding the adjuster along the wire, can be eliminated by adding a jumper to the standard adjustable element between the arm of the slider and the end of the 64 ohm resistor on the wire-wound core. The element would then be the 1000 ohm element with the 64 ohm core in series connected between the terminals. The arm of the slider would be connected to one terminal and merely short out part of the 64 ohms. This would eliminate the possibility of an arc between the slider and the wire, and then the adjustable element would have only the possible hazard of the element wire breaking, the same as the fixed element.

The humidity element carries less current than the temperature element. The maximum current possible in the humidity element would be caused by an element being completely shorted and then breaking the connection. This could give a maximum current of 1 milliampere across a 6 volt potential, or a maximum of .006 watts. This maximum is possible only if the control point potentiometer is at the extreme CW end. Normally, the current through the humidity element is not more than .04 milliamperes even at the high humidity end. So the arc caused by the breaking of a humidity element is practically negligible.

To thoroughly check the temperature sensing devices, the control center was by-passed and voltage was fed from a rheostat directly to the sensing element. Periodically, ether, oxygen and ether-oxygen mixtures, in explosive concentrations, were directed against the sensing element.

It was observed that the temperature of the sensing element rose approximately 70 deg F per 50 volt increment of increase up to 200 volts. At 200 volts and a 350 deg temperature, a slight odor was detected. At 210 volts and a 355 deg temperature, a faint smoking was observed. At 230 volts and at a 375 deg temperature, no glow was visible. At 240 volts and at a 375 deg temperature, an ether-oxygen mixture produced a slight explosion and slight showering of sparks.

Since the humidity sensing element has a resistance of 36,000 ohms and employs the same bridge circuit as the tested temperature sensing element, all conclusions pertinent to the safety of the temperature element are conservative and valid for the humidity element as well.

Conclusions

As a result of the study made of the explosion hazards of electronic temperature and humidity control systems, a few of the conclusions agreed upon are submitted:

1. The electronic sensing devices are intrinsically safe at normal operating amperage and voltage for use in hazardous locations in hospitals.
2. Electronic sensing devices must be designed and constructed of such materials that failure will not occur at potentials less than 220 volts a-c; temperature at maximum applied voltage cannot exceed 365 deg F.
3. Finally, the control panel and the power source for the ventilating system should be connected to the emergency power supply for continued functioning in the event of regular power failure.

Acknowledgments

The author is grateful to John P. Watson and his associates from the Veterans Administration for their collaboration in this research project.

An economic evaluation of

Heat Rejection Methods

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A large amount of factual information is presented on the engineering economics for various methods for rejecting the heat removed from air conditioning systems. Studies are tabulated for cooling seasons of various operating hours.

HEAT removed from the conditioned space by the air conditioning system is dissipated or rejected by several different methods. It is often rejected to the outside air by means of cooling towers, evaporative or air condensers. Sometimes this heat is rejected to the city water, to wells, or to river or lake water.

An analysis is presented of the overall owning and operating costs of some of the commonly used heat rejection methods. Specifically, it shows the difference in overall costs for a system of 50-ton capacity with the following conditions: city water, cooling tower, evaporative condenser, and air condenser. The data have been summarized in dollars per ton per year and for systems having a cooling season ranging from 1000 to 7000 hours, and are based on 1958 prices. The price figures will have to be adjusted for 1960 but the relationship between cost items remains.

Table 1 shows the pertinent data with respect to operating conditions and temperature levels. Table 2 lists the first costs, fixed charges and the operating costs for this 50-ton system when a 1500 hr cooling season occurs. Average cost for electrical energy including demand for this study is $0.02 per kwh; water costs $1.60 per 1000 cu ft, and load factor, 0.70.

The significant data are the operating cost per ton; fixed charges per ton; and overall owning and operating cost per ton. For these specific conditions, system *A* which uses city water for heat rejection, has the lowest overall cost. Many cities will not permit the use of city water, so that the selection should be between Systems *B*, *C*, or *D*. The economic optimum according to this study, is System *D*, the air cooled condenser. A higher rate for electricity will favor System *C*, evaporative condenser, because of the lower installed horsepower and reduced kwh.

Operating costs for other conditions are listed in Tables 3 and 4.

Maurice J. Wilson, commercial equipment sales manager of the Unitary Equipment Division, Carrier Corp., Syracuse, N. Y., is the holder of two degrees —one in mathematics from Drury College and other in electrical engineering from Georgia Institute of Technology. From 1937 to 1941 he supervised the engineering and installation of air conditioning in prominent structures throughout the world, traveling to Russia, France, South America and the Caribbean. He worked with the late Dr. Willis H. Carrier in designing wind tunnels for military needs during World War II. In all, he has had 30 years experience in the air conditioning field and was closely associated with the development of the Carrier Conduit Weathermaster System. Mr. Wilson has lectured before many technical groups.

TABLE 1—OPERATING CONDITIONS AND TEMPERATURE LEVELS

Item	Unit	System A–City Water Condenser	System B–Cooling Tower	System C–Evap. Cond.	System D–Air Cooled Condenser
Capacity	Tons	50	50	50	50
Suction temp.	Deg F	40	40	40	40
Condensing temp.	Deg F	105	105	105	120
Design D.B.	Deg F	95	95	95	95
Design W.B.	Deg F	76	76	76	76
City water temp. (max.)	Deg F	72	72	72	72
Compressor	BHP	51.0	51.0	51.0	60.0
Condenser pump	BHP	—	2.9	—	—
Cooling tower fan	BHP	—	1.5	—	—
Evaporative condenser fan and pump	BHP	—	—	5.5	—
Air condenser fan	BHP	—	—	—	7.5
Design	GPM	54	160	—	—
Fixed charges		$990.00	$1,420.00	$1,380.00	$1,490.00
Fixed charges/ton		19.80	28.40	27.60	29.80

TABLE 2—OPERATING COSTS FOR 1500-HOUR COOLING SEASON

Item	System A—City Water Condenser		System B—Cooling Tower		System C—Evaporative Condensers		System D—Air Cooled Condensers	
	$	%	$	%	$	%	$	%
Electric compressor	910.00	53	910.00	53	910.00	55	1,060.00	69
Electric auxiliary	——	—	116.00	7	145.00	9	198.00	13
Water	620.00	36	95.00	6	95.00	6	——	—
Water treating	——	—	150.00	9	150.00	9	——	—
Maintenance and service	75.00	5	250.00	15	200.00	12	150.00	10
Spare parts—refrig., oil, belts, etc.	100.00	6	175.00	10	150.00	9	125.00	8
Total operating cost	1,705.00	100	1,696.00	100	1,650.00	100	1,533.00	100
Operating cost/ton	34.10		33.92		33.00		30.66	
Fixed charges/ton	19.80		28.40		27.60		29.80	
Overall operating and owning cost per ton	53.90		62.32		60.60		60.46	

Electrical cost (energy plus demand) $0.020 kwh; water cost, $1.60 per 1000 cu ft; load factor, 0.70.

TABLE 3—OPERATING COSTS FOR 3000-HOUR COOLING SEASON

Item	System A—City Water Condenser		System B—Cooling Tower		System C—Evaporative Condensers		System D—Air Cooled Condensers	
	$	%	$	%	$	%	$	%
Electric compressor	1,360.00	53	1,360.00	58	1,360.00	58	1,575.00	70
Electric auxiliary	——	—	203.00	8	255.00	11	345.00	15
Water	1,010.00	39	154.00	6	154.00	6.5	——	—
Water treating	——	—	200.00	8	200.00	8	——	—
Maintenance and service	85.00	3	275.00	12	225.00	9.5	175.00	8
Spares—refrig., oil, belts, etc.	125.00	5	200.00	8	175.00	7	150.00	7
Total operating cost	2,580.00	100	2,392.00	100	2,369.00	100	2,245.00	100
Operating cost/ton	51.60		47.80		47.30		44.90	
Fixed charges/ton	19.80		28.40		27.60		29.80	
Overall operating and owning cost per ton	71.40		76.20		74.90		74.70	

Electrical costs (energy plus demand). $0.0175 per kwh; water costs, $1.52 per 1000 cu ft; load factor, 0.60.

TABLE 4—OPERATING COSTS FOR 6000-HOUR COOLING SEASON

Item	System A—City Water Condenser		System B—Cooling Tower		System C—Evaporative Condensers		System D—Air Cooled Condensers	
	$	%	$	%	$	%	$	%
Electric compressor	2,140.00	56	2,140.00	62	2,140.00	62	2,480.00	72
Electric auxiliary	——	—	348.00	10	435.00	12	595.00	17
Water	1,450.00	38	223.00	6	223.00	6	——	—
Water treating	——	—	250.00	7	250.00	7	——	—
Maintenance and service	100.00	2	300.00	9	250.00	7	200.00	6
Spares—refrig., oil, belts, etc.	150.00	4	225.00	6	200.00	6	175.00	5
Total operating cost	3,840.00	100	3,486.00	100	3,498.00	100	3,440.00	100
Operating cost/ton	76.80		69.70		69.90		68.80	
Fixed charges/ton	19.80		28.40		27.60		29.80	
Overall owning and operating costs per ton	96.60		98.10		97.50		98.60	

Electrical costs (energy plus demand), $0.015 per kwh; water costs, $1.45 per 1000 cu ft; load factor, 0.55.

TABLE 5—COSTS FOR A 50-TON CAPACITY COMFORT AIR CONDITIONING SYSTEM

Item	System A—City Water Condenser	System B—Cooling Tower	System C—Evaporative Condensers	System D—Air Cooled Condensers
Motor, starter and compressor	$3,530	$ 3,530	$ 3,530	$ 3,780
Water condenser	910	910	—	—
Cooling tower	—	1,250	—	—
Evaporative condenser	—	—	2,180	—
Air condenser	—	—	—	2,850
Motor and pump	—	300	—	—
Water piping	125	550	—	—
Refrigerant piping	—	—	300	300
Receiver	—	—	160	160
Refrigerant	60	60	90	80
Condenser water regulator	250	—	—	—
Condenser pressure control valve	—	—	—	125
Discharge damper on evaporator	—	—	250	—
Make-up and drain piping	—	100	100	—
Labor	600	800	1,000	1,000
Water treatment	—	150	110	—
Miscellaneous	500	700	700	700
Cartage, handling and freight	250	250	350	300
Electrical wiring	1,500	2,000	2,000	2,400
Grillage and foundation	300	600	500	500
Total	$8,025	$11,200	$11,270	$12,195

Figure 1 shows the overall cost per ton per year for the four different methods with cooling season extending up to approximately 7000 hours per year. Such an operating period would occur in hotels, motels, and hospitals in the southern section of the United States. Longer operating seasons and greater electrical and water consumption per month will usually reduce slightly the unit cost for these two items. The load factor, or the average loading per unit of operating time, will also be lower. These factors have been included in the study and their effect is indicated by the shape and slope of the curves. The conclusions indicated by this analysis and based on the specific conditions outlined are:

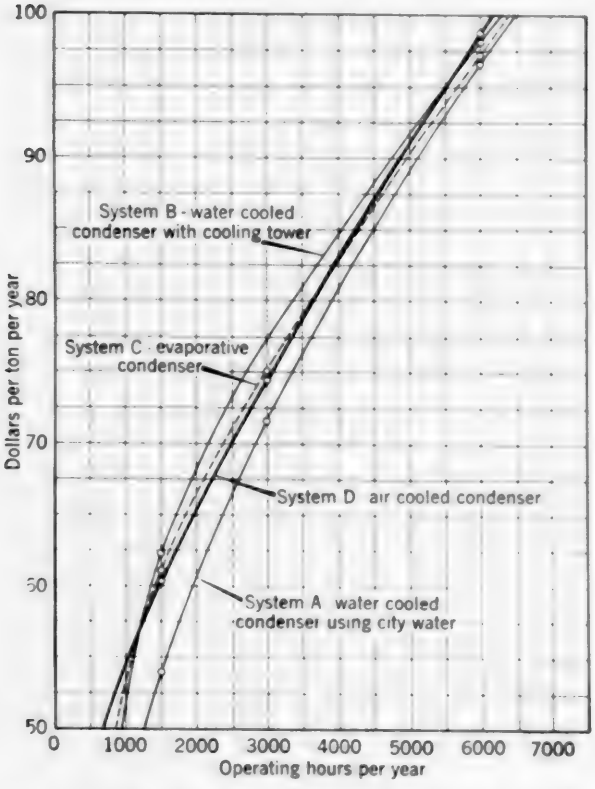

Fig. 1. Yearly operating costs for four types of systems, and for various yearly operating hours.

1. Heat rejection by means of city water is the lowest on overall cost. It must be recognized, however, that many localities will not permit such a method.

2. Air rejection is the lowest overall cost for an operating season of 1100 to 4000 hours or for the majority of the applications. Ambient dry bulb temperature, electrical costs and operating season, however, can change appreciably the cost relationship indicated. For example, an increase of 10% in the electrical rate will make the evaporative condenser method more economical.

3. Quality of the water required by methods *A*, *B*, and *C* can also affect adversely the relative overall costs for these three systems.

Included with the study are data, Table 5, whereby changes in the overall cost may be readily determined for different electrical and water costs and for different operating periods or for different load factors.

CENTRIFUGAL FAN APPLICATION GUIDE: PART 4—

Will the Fan Vibrate?

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Fans vibrate in spite of careful selection by the system designer and the manufacturer's balancing equipment. While in most cases the vibration is small enough to be considered satisfactory, occasionally it is excessive. Who is to blame: manufacturer, designer, structural engineer, or freight handler? Part 4 of this series helps to pinpoint the responsibility by reviewing the common causes of vibration, the ways to prevent it, and what to do if vibration is excessive.

What Causes Fans to Shake?

Fans usually have six rotating components: wheel, shaft, driven sheave, belts, driver sheave, and motor. If all six could be balanced perfectly by their respective manufacturers, shipped to the job site, installed without damage, and kept absolutely clean in operation, there would be negligible vibration due to unbalance.

These ideal conditions do not exist. There is no such thing as perfect balance. Parts are stressed in shipment and installation. An installation that stays as clean as new is a rare one. Parts become unbalanced from the effects of erosion, abrasion, or the deposit of air-borne material on wheel blades.

Balance is relative. It can be measured in ounce-inches of residual unbalance, representing the sensitivity of the balancing device, or in terms thousandths of inches of movement caused by the unbalance when mounted upon a specific foundation. These and other evaluations are only indicative of the precision of the manufacturer and are not necessarily indicative of vibration that will occur on a job.

There are causes of vibration not related to unbalance. One of these occurs when a poorly designed fan inlet or outlet connection results in abruptly changing flow patterns that shake the fan and duct. The remedy is a corrected connection or addition or splitters and vanes. (See Part 2 of this series on inlet and outlet connections.)

Also not related to unbalance is vibration which occurs when some types of fans are throttled too close to shut-off and surge or pulsate. This phenomena is best avoided by careful resistance calculations and by using fans, such as flow-nozzle airfoils, that are stable over a broad performance range. The phenomena can usually be pinpointed by opening duct or plenum doors to allow considerably more air to flow through the fan. If the vibration stops, it is caused by excessive throttling and not by unbalance.

Still another source of vibration not associated with unbalance is that caused by air flowing from the blade channels and pulsating against the fan housing cut-off. This is caused by non-uniform flow velocities through the blade channels and is minimized by use of fans with maximum uniformity of flow. Again, the flow-nozzle airfoil is recommended. Vibration set up by this pulsating action is at a frequency equal to number of blades times fan speed, and can be of more importance than fan unbalance.

When fans vibrate, a small part of its motive power is converted to vibrational energy. The greater the unbalance, the greater the vibrational energy, and:

1. If fan and motor are tied down to a massive foundation, the energy will not evidence itself as vibration. Rather, it will be dissipated in the bearings, structure, and foundation.

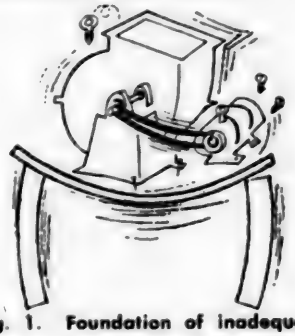


Fig. 1. Foundation of inadequate mass, and inadequately braced, allows fan to vibrate and will vibrate with the fan.

Fig. 2. Light foundation will allow fan to bounce, somewhat like an acrobat on a trampoline.

2. If the foundation is light, but adequately braced to prevent vibration, the energy will pass through to some other part of the building that either has the mass to absorb, or lacking this mass, will vibrate.

3. If the foundation is of inadequate mass and is inadequately braced, it will allow the fan to vibrate and will vibrate with the fan. See Fig. 1.

4. If the foundation is light and happens to have a natural frequency of vibration close to the speed of the fan, drive, or motor, it is apt to amplify the vibrational energy, somewhat like an acrobat on a trampoline. (See Fig. 2.)

Which of the Fans Are the Least Likely to Vibrate?

Certain construction features offer better natural resistance to vibration than do others. These are:

1. An Arrangement 3 fan, with its wheel suspended between bearings, is less susceptible to vibration than is an Arrangement 1 fan which has an overhung wheel. This is simply because Arrangement 3 provides support on both sides of the wheel, while in Arrangement 1, the fan has the wheel where it can use the shaft as a reed.

2. Mass (weight) in the fan structure is desirable because mass absorbs vibration. At the same time, mass in the rotating parts may be either desirable or undesirable. The smaller the amount of weight revolved, the better the initial balance that can be achieved. So, where fans are to be used in clean ventilating systems, the wheels should be constructed of light weight metal. Conversely, though, wheels for industrial processes should be massive in order to withstand the severe maintenance conditions met with in such applications.

Since some newer aluminum alloys combine light weight with strengths superior to steel, it seems reasonable that airfoil ventilating fans should have aluminum wheels in order to minimize revolved mass and vibration.

3. Fans to operate at or above Class II (3¾ inches total pressure and higher) should be test run in the manufacturer's plant prior to shipment and checked for vibration at the bearings and at the housing extremities.

How Good Are Vibration Bases?

Although one dislikes making all-inclusive statements, as *"All ventilation fans should be mounted on isolation bases,"* it is difficult to imagine a ventilating system that should not have them. The energy of vibration, no matter how small, must go somewhere. A vibration base between a fan and a massive foundation is probably superfluous, but in the majority of ventilation systems it provides assurance of better operation.

All isolation bases work on the principle that a small amount of resilient material, placed between the rotating equipment and the foundation, will absorb vibration energy and prevent its transmission to the foundation, provided that the natural period of vibration of the isolation material is much different than any of the rotational frequencies.

Three of the most common materials are rubber-in-shear, cork, and steel springs. Manufacturers of isolation bases offer four principal types:

1. Pads of isolation material affixed with studs or holes for mounting are used either under packaged fans or to suspend packaged units. (*Packaged* means the motor and drive are mounted on the fan or unit, and the package isolated from the foundation.) This method is quite economical. The pads are usually rubber-in-shear or ribbed rubber and cork. See Fig. 3.

2. When fan and motor are mounted separately, the isolation base must form a rigid base under both and hold them apart while isolating them from the floor. If they are not held apart by this integral base, tension in the V-belt drive will place some parts of the isolation material in tension rather than compression and the starting torque will distort the drive and cause the assembly to rock.

Integral isolation bases usually used under fans are relatively inexpensive and designed to do a good job in all but the most sensitive applications. See Fig. 4.

3. When especially sensitive applications are anticipated, the bases may be designed for the individual combinations of fan weight, motor weight, fan, drive, and motor speeds. These bases gen-

Fig. 3. Rubber-In-Shear isolation pad. Photo courtesy of Vibration Eliminator Company, Long Island City, N. Y.

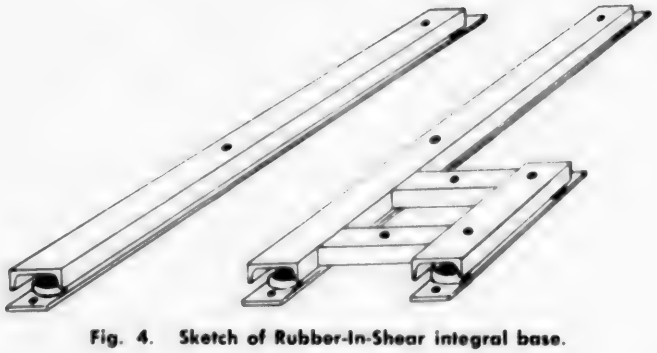


Fig. 4. Sketch of Rubber-In-Shear integral base.

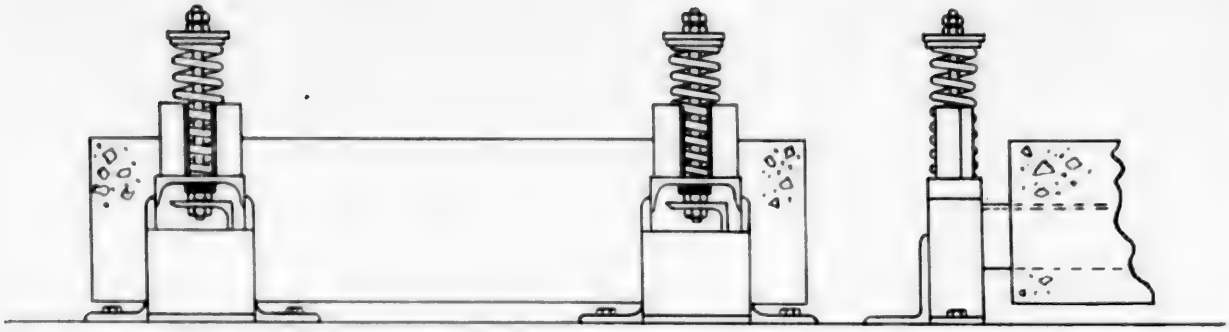


Fig. 5. Sketch of reinforced concrete pad set on spring isolators. Courtesy of Vibration Eliminator Company.

erally use rubber-in-shear, springs, or a combination of the two. Needless to say, such bases are both better and more expensive than the pre-selected ones.

4. Where floor conditions permit, one of the best fan bases is made by lagging fan and motor to a reinforced concrete pad set on rubber-in-shear or spring isolators. The concrete pad serves as an inertial mass to limit amplitude of vibration and to dissipate some of the vibrational energy. See Fig. 5.

What About the Building Structure or Fan Platforms?

It is surprising how many fans are mounted on structures that are inadequate. This condition usually may be the result of a lack of appreciation on the part of the structural designer that the structure must support a dynamic load, or it may be that an old building structure, designed for dead loads only, is used. The advent of high pressure systems has caused the scrapping of many an old practice of plenum construction and of duct design.

The following rules will help avoid designing structures susceptible to vibration:

1. Floors or structures supporting fans should be designed to avoid resonance with any disturbing frequency. If the structure is very simple, its deflection may be calculated by the beam formulas. Its cycle of vibration will equal 187.7 divided by the square root of the deflection in inches. To avoid vibration, this should be 25% or more greater than the number of revolutions per minute of the fan and/or motor.

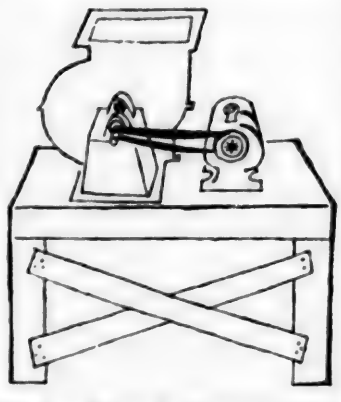


Fig. 6. Generous diagonal bracing strengthens platform.

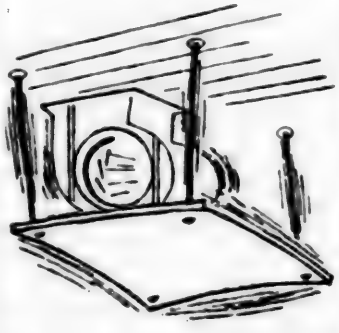


Fig. 7. Small-diameter support rods may let platform sway.

2. Use the same method to check plenum walls if their construction is simple enough to allow deflection calculation. Check both fan plenums and false ceiling or extended type plenums. The load to use to calculate the static deflection is the pounds per square inch or square foot resulting from the static pressure. Multiply inches of static pressure by 0.036 to obtain pounds per square inch, and by 5.2 to obtain pounds per square foot.

3. Existing building structures should be carefully examined. If in doubt as to the value of the existing structure's ability to handle the new dynamic load, it may be a wise investment to ask the fan manufacturer to supply a specifically designed isolation base.

4. Wherever possible, fan should be set directly over vertical supports to gain maximum rigidity, with generous diagonal bracing added. See Fig. 6.

5. Where the fan is suspended on a platform, the hangers should be diagonally braced to prevent swaying. (Small diameter rods may have strength enough to support a platform but not be rigid enough to prevent it from swaying.) Refer to Fig. 7.

If, after the Fan Is Installed, it Vibrates, What Then?

Fans vibrate excessively sometimes, despite all the care taken to prevent it. Correcting the condition can be a short job or it can take hours, depending upon what caused the unbalance and how sensitive is the foundation.

The following steps are designed to pinpoint the cause and remedy the condition:

1. Open up the system to let more air through it. If vibration decreases, it is caused by air turbulence and not unbalance. Check the system capacity (as will be explained in Part 5 in this series). This is usually an indication that the fan is starved for air. It can also be caused by a poor fan inlet.

2. Carefully inspect all fan, drive, and motor parts for obvious damage or misalignment. If none is found, hold a pencil to the shaft near the sheave and wheel and rotate slowly. If continuous pencil lines are formed, the shaft is probably straight. Check the outside diameter of the sheave the same way. Also check the face of the sheave in this manner to see if it is on crooked.

3. Check the motor shaft and sheave the same way.

4. Check the alignment of the belts or couplings with a straight edge.

5. Check drive grooves and belts for dirt. Check fan wheel for dirt.

6. Check all foundations, bearings, motor bolts, fan wheels, fan sheaves, bearings, and motor sheave set screws for tightness.

7. Check the fan structure and the sub-structure, platform or foundation for rigidity. These should "feel" rigid and tight; should have sufficient sway bracing, and not bounce.

8. Run the fan for 15 or 20 minutes to warm up bearings. Then remove the belts. Turn the motor on. If it vibrates, remove the motor sheave and run again. If it runs smooth, discard the motor sheave or have it machine balanced. If the motor still runs rough, it should be turned over to a competent motor service company or to the motor manufacturer.

9. Block off the fan inlet or outlet to prevent fan rotation due to stack effect.

10. Number fan blades to keep track of weight placement.

11. Rotate wheel by hand, such that wheel will make at least ten revolutions before stopping. Alternate rotation clockwise and counter-

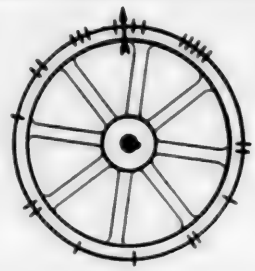


Fig. 8. Marks on pulley from static balance test. The arrow indicates a light point.

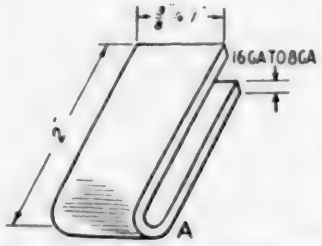


Fig. 9. Typical balance weight. Bend at "A".

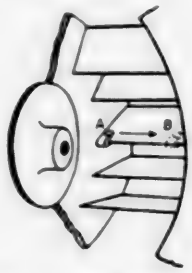


Fig. 10. Showing weight placement close to back plate "A". Moving weight closer to front plate "B" often helps.

clockwise. Mark at the top of pulley or coupling, each time, the point at which the wheel stops. If stopping points vary considerably in location, continue the operation until a definite pattern develops at some point. See Fig. 8. Twenty or thirty marks may be necessary to establish a definite pattern.

12. Select a U-shaped weight (Fig. 9) and attach at the light point of the wheel, as in Fig. 10. If the light point is definitely between two blades, use two small weights, one on each of the adjoining blades. Do not remove any factory installed weights.

13. Remove the pulley marks and proceed again as in Step 11. If the pattern shows up in the same position, the weight is too light and must be increased. If the pattern is offset from the original position, move the weight or weights around the wheel in the same direction as the offset. Alter weights as necessary and proceed as in Step 11. Continue this procedure until results show no definite pattern.

14. Attach coupling or V-drive, and check fan operation. If operation is satisfactory, drill through weight and blade, and rivet or tack weld in position.

15. If vibration is not sufficiently corrected, then

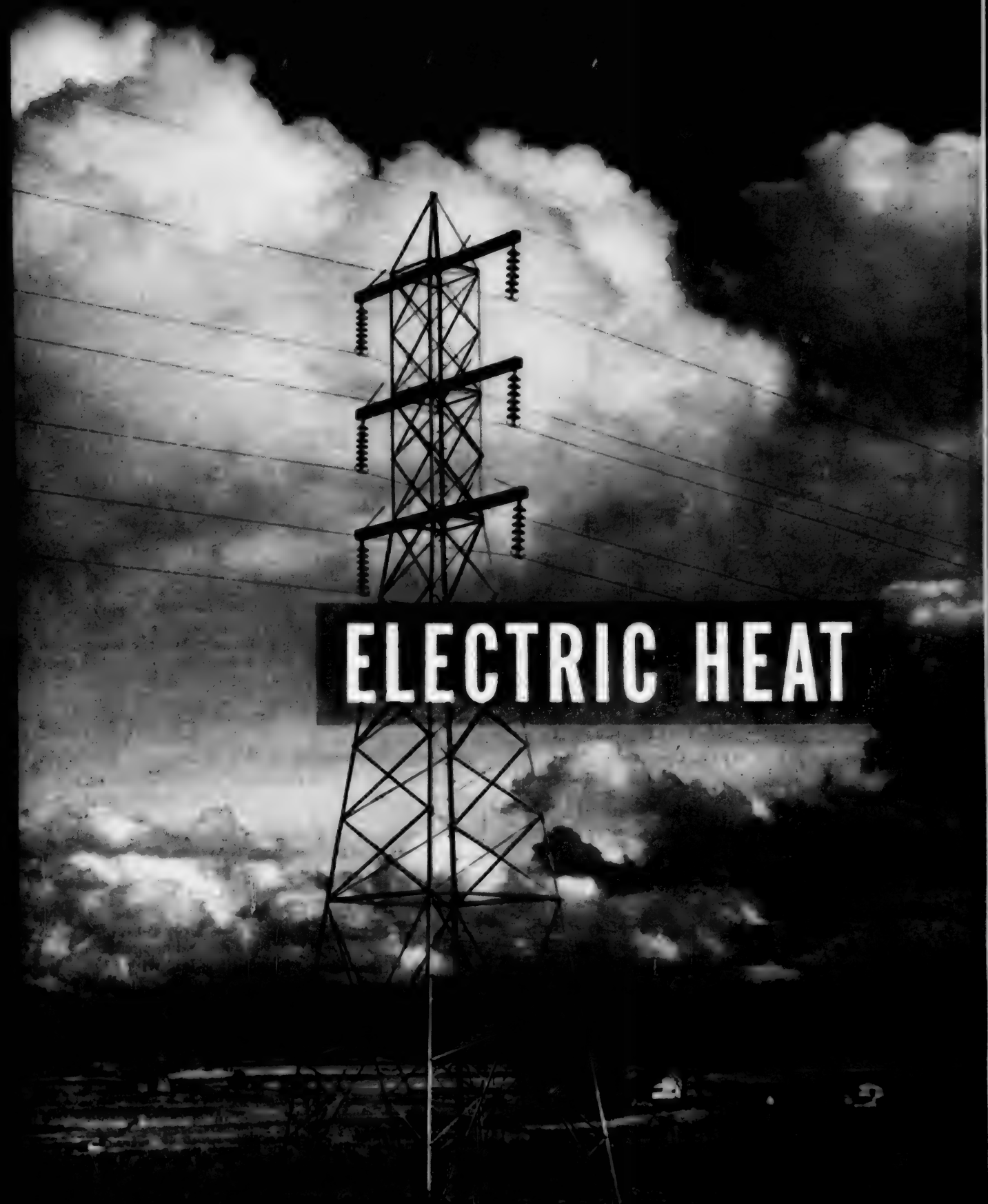
(a) static balance is not sufficiently corrected,
(b) driven sheave is out of balance, or
(c) the wheel is badly out of dynamic balance.

Since (c) is the least likely, remove marks on pulley and check static procedure, Step 11, again. If results are consistent, the driven sheave, if of sufficient size, may be out of balance and cause the vibration. Remove the sheave and check as in Step 11, above, putting marks on the end of the shaft. If the results are not consistent with those above, the sheave is out of balance and another should be used. It will then be necessary to remove field balance weights and recheck the wheel for static balance.

16. To correct dynamic unbalance, select two equal weights, place one on, (say blade 1) next to the back plate, and the other on blade 7 (opposite blade) next to the front plate, proceeding around the wheel to 2 and 8, 3 and 9, etc., checking the operation at each point until the best operating position is found. If further improvement is necessary, increase or decrease the amount of the weights until satisfactory performance is secured.

17. The higher friction co-efficient of sleeve bearings makes the foregoing process difficult to apply. In this case, balance can be secured by a cut and try method. Select any blade and attach a weight, running the fan to try for balance, and changing the location around the wheel clockwise or counterclockwise until the best position is found. Increase or decrease weight to secure best operation.

(With Part 5, which appears next month, the series is concluded)



AIR CONDITIONING, HEATING AND VENTILATING'S REFERENCE SECTION

Design and Application for Electric Heat

During the past few years, electric space heating has had a high rate of growth. Unquestionably, electric heating has materially improved competitively. It has been found that the higher electrical energy cost ceases to be a dominant factor if the many favorable design and application practices are effectively utilized. While at present most of the installations have been made in residences, there is a growing use of this type of heat in schools, motels and commercial installations. This article covers the various forms of electric heat being used, and design practices that should be followed to achieve economy of operation.

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ELECTRIC space heating, during the past few years, has increased in popularity and public acceptance. One contributing factor to this almost phenomenal growth is that electric space heating can be supplied by either the heat pump or by resistance type units. The heat pump employs the refrigeration cycle to furnish year-round heating and cooling, while the resistance units generate useful heat by direct conversion of electrical into thermal energy at 100% efficiency. The direct heating units are generally selected for applications where heating only is desired; they can also be practical and economical in combination with motor driven cooling equipment to furnish year-round air conditioning. The attractiveness of either the heat pump or direct electric heating are further enhanced by the fact that they can be used independently or as a supplement to each other to give a number of desirable advantages over competitive systems.

Therefore, because of their many common characteristics, the logical procedure would be to jointly discuss the operation and performance of these two types of electric air conditioning. This article, however, will be confined to direct electric heating, since the heat pump has been extensively and adequately covered by previous articles.

Installations in the United States

Before examining the most promising practices for full utilization of the inherent characteristics of direct electric heating, it will be informative to examine Table 1 which lists the number of installations and operating costs which can be expected in the immediate future. The number of installations is given for the past two years, in the different sections of the country, together with the measured average kilowatt-hours, heating cost, and related average electric rates. This table shows a total of 545,000 residential installations in the United States at the end of 1959 as compared with 460,000 installations for the same period in 1958. The 85,000 new installations, during this one-year period, are representative of the average rate of increase over the past three years. The majority of the residential installations have been made in new houses, but in some areas the old homes' market represent about 25 to 30% of the total.

In addition to the 545,000 residential installations, there are an estimated 98,700 commercial installations in the United States, of which 68,400 are motels. The geographic breakdown of these installations is also included in Table 1.

Residential Equipment Available

The great majority of these 545,000 residential installations can be divided into five general design classifications. Heating cable installations lead with 170,000, followed by 153,000, natural convection; 94,000, baseboard; 73,000, forced convection; and 25,000, radiant. The remaining 30,000 installations consist of portable units, electric furnaces and other miscellaneous designs. The usual location of the common types of electric heating are shown in Fig. 1.

Heating Cable, representing 31% of the total installations, is particularly well adapted for new constructions and can be embedded in the ceilings, floors or sidewalls to supply uniform heat over the entire area. The 120 or 240-volt cable is approximately ⅛ to ¼ inch in diameter and usually is covered with a plastic insulation. It is available in a variety of

lengths from 17 to 2600 ft, with a heating effect in the neighborhood of 2.8 watts per linear foot. In addition, a heavy duty, lead jacketed 115, 230 or 460-volt cable, with a heating capacity of 7 to 10 watts per linear foot, is available for concrete floor systems. The heating cable is laid forth and back on the flat surface with a definite space between turns. The heating output in each area is under control of an individual thermostat.

Wall Units, either natural or forced convection, representing 28 and 13%, respectively, of the total installations, consist of a coil of high resistance wire wound around a porcelain or ceramic tube or an insulated wire embedded in a finned metal casing. In some types, a polished sheet of metal is placed behind the heating metal to act as a reflector. These heaters have one or more heating elements that range in total capacity from 1000 to 8000 watts, although 4000 watts is usually the maximum recommended for residential use.

Baseboard natural convection units, representing 17% of the total installations, can be either recessed or surface mounted along the exterior wall. The units have a length of about 2 to 12 ft and vary in height from 3½ to 10 inches. The heating elements are rated from 100 to 400 watts per linear foot and operate at either 120 or 240 volts. The heaters may be controlled by either a line or low voltage wall type thermostat, or by a specially designed thermostat located in the baseboard section.

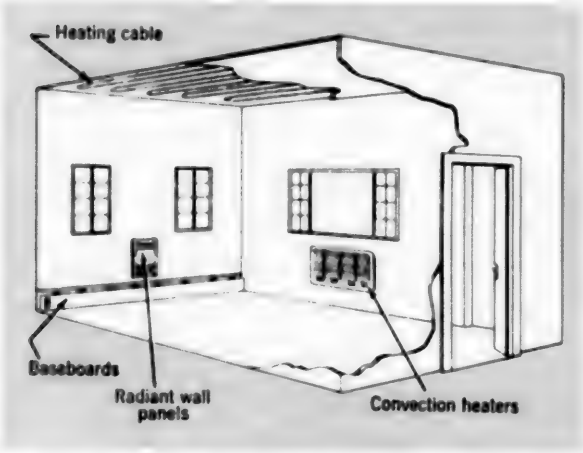

Fig. 1. Preferable location of the various direct electric heating units.

Radiant wall panels, representing 5% of the total installations, can be either glass, ceramic or metal alloy for recessed or surface mountings. These panels are of many sizes, shapes and designs, and their temperature, when energized, is usually in the neighborhood of 325 to 400 deg F. The heaters are sized from 500 to 3000 watts, at 120 or 240 volts, and are controlled by either low voltage or line voltage thermostats.

Central Electric Furnaces: Air and Water Types

Unquestionably, the ability to generate the heat when and where needed, and thereby to take full advantage of the many possible economic reductions in the heating requirements of the structure, has contributed greatly to the acceptability of electric systems.

Some interest and activity, however, have recently been apparent, particularly among manufacturers and contractors, in the central type electric unit. This equipment, for the most part, is similar to comparable fuel-fired designs, except electric heating elements are substituted for the steam or hot water coils. Such units provide air circulation, filtering and humidification as required and, with the addition of a cooling coil and condensing unit, will also supply summer air conditioning.

The central electric furnace offers attractive first cost possibilities and the operating cost need not be any higher than the individual in-the-room type of unit, providing a well-designed distribution system is employed. The importance of an acceptable method of delivering the heating medium to and from the

TABLE I—INSTALLATIONS AND OPERATING CHARACTERISTICS OF ELECTRIC SPACE HEATING INSTALLATIONS IN U.S.

Section	Residential				Commercial		
	No. of Installations	Av. Elec. Rate for Heating	KWH	Annual Cost	No. of Installations		
					Motels	Others	Total
Northeast	9,500	1.72	15,072	$259	1,400	600	2,000
South	290,000	0.88	12,200	107	31,000	8,200	39,200
Midwest	50,500	1.57	15,170	238	13,000	3,600	16,600
West	195,000	1.1	15,373	169	23,000	17,900	40,900
1959 — All Sections	545,000	1.04	13,636	144	68,400	30,300	98,700
1958 — All Sections	460,000	1.02	12,433	124	—	—	—

Data from Electric Heat and Air Conditioning, November-December 1959 Issue

CAPITAL INVESTMENT	Electric	Fuel
1. Electric Heating Elements	xx	
2. Power and Control Wiring	xx	xx
3. Controls	xx	xx
4. Boilers and Auxiliary Equipment, Condensate Pumps, Motors, Storage Tanks, Fuel Piping, Etc.		xx
5. Piping, Pipe Insulation, Valves, Fittings, Etc.		xx
6. Ducts and Duct Insulation		xx
7. Additional Floor Area (Required for Equipment)		xx
8. Miscellaneous	xx	xx
9. Total First Cost	xxx	xxx
ANNUAL FIXED CHARGES		
1. Amortization and Depreciation of Equipment		
Electric Heating Equipment, Power and Control Wiring (Life same as Building)	xx	xx
Electric Starting Equipment (20 Year Life)	xx	xx
Controls (15 Year Life)	xx	xx
Valves and Specialities (10 Year Life)		xx
Boiler and Auxiliaries, Steam and Water Piping, Fittings and Ducts (Life of Building)		xx
Duct Insulation (20 Year Life)		xx
Fans (15 Year Life)		xx
Miscellaneous	xx	xx
2. Interest	xx	xx
3. Taxes	xx	xx
4. Insurance and Inspection Fees (Boiler, Heating Equipment and Building	xx	xx
5. Total Annual Fixed Charges	xx	xx
ANNUAL OPERATING COST		
1. Electric Power Costs		
Heating Elements, Controls, Fan and Pump Motors, Etc.	xx	xx
2. Fuel Cost		xx
3. Boiler, Ducts and Piping Costs, Boiler Room Supplies, Water Treatment, Lubricating Oil and Grease, Corrosion Protection Painting, Maintenance Service (Flue, Stacks, Fire Side of Boiler, Etc.) Replacement of Worn Parts, Makeup Water, Wages of Engineer or Operator, Janitor and Housekeeping		xx
4. General Maintenance Service Cost	xx	xx
5. Total Annual Operating Cost	xxx	xxx
SUMMARY		
Annual Fixed Charges	xx	xx
Annual Operating Cost	xx	xx
Total Owning and Operating Cost (Today)	xxx	xxx
Total Estimated Owning and Operating Cost (10 Years Hence)	xxx	xxx

Fig. 2. Annual owning and operating cost evaluation. Important factors are the electric power and fuel costs.

occupied space, however, cannot be overemphasized. Proper precautions must be taken to minimize the distribution losses and to prevent overheating of the space, due to the lack of zoning. If this is not done, the central system will certainly cause considerable dissatisfaction and excessive operating costs.

Utilities Interest

The electric utilities have a particular interest in electric space heating, because of its tremendous potential market and the attractive possibilities it offers for a compensating winter demand to offset the summer peaks caused by air conditioning and accessory equipment. This shift in the peak electric demand from winter to summer is now becoming increasingly prevalent in different areas of the nation. In 1959, for the country as a whole, 42% of the companies had a 17% high summer peak, and in the south, 72% of the companies had a 23% high summer peak.

It is, therefore, obviously important to the electric utility to encourage a winter load, such as electric heating, in order to offset the adverse effect of the increasing summer air conditioning load on its generating facilities.

Owning and Operating Cost

The present and future growth of electric space heating, however, will not be determined exclusively by the interest and efforts of the utilities and manufacturers, but instead will be governed, for the most part, by the degree of full public acceptance which it is able to obtain. To get this acceptability, electric heating must have a favorable, annual owning and operating cost when compared with competitive systems. Such an annual cost evaluation must include all of the influencing items, such as:

1. Capital investment of the two systems being compared.
2. Annual fixed charges due to the amortization and depreciation of equipment, the interest and taxes.
3. Annual operating cost of heating energy, the boilers, pumps and miscellaneous equipment.

In comparing the annual owning and operating cost of electric heating and fuel systems, it will be found that a check list, as illustrated by Fig. 2, can be very helpful in order to make sure that all of the necessary items are included.

Fuel Cost Comparison

Two of the important items in any owning and operating cost evaluation, such as shown by Fig. 2, are the electric power and fuel costs. These costs naturally vary, depending upon the geographic location and other influencing factors and, consequently, individual and independent comparisons must be made in most cases. What is generally overlooked in such comparisons, is the improved position of electric energy during the past few years, because of the continuing and cumulative increases in the cost of competitive fossil fuels. This is illustrated in Fig. 3 which shows the retail price index of fuels and electricity for 1935 through 1957, using 1947-49 as a base of 100. It can be noted that, during the ten-year period between 1948 and 1958, the retail price index of bituminous coal has risen about 25%, gas 30%, oil 20%, and in contrast the average electricity cost has decreased 15% for the country as a whole. What is even more important is that every development points towards a comtinuation of this trend in fuel costs. It is significant that the electric power industry, largest

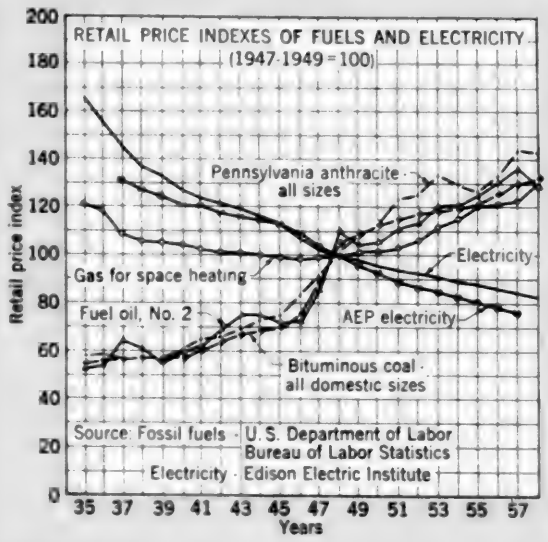

Fig. 3. Comparison of the retail price indexes of fuels and electricity.

users of fossil fuel, continues to make notable improvements in cost of their power generation, transmission and distribution so that there is a solid basis for believing that the industry can retain and even improve this favorable trend.

In Fig. 3, the curves for electricity are the cost per KW-hour to residential customers, based on the average monthly use of electricity in the home for various applications.

The composite average fuel retail price indexes, shown by curves of Fig. 3, are based upon data collected from 46 index cities which are generally quite large, such as Atlanta, Chicago, New York, Pittsburgh, Minneapolis, San Francisco, and the like. As a consequence, these average retail price indexes are useful to show the trend of the nation as a whole, but may not be applicable to one particular area.

An energy cost analysis should not be limited to present-day prices but must be projected 5 and 10 years in the future to get a true operating cost comparison of various systems. Viewed in this way, it is

believed that electric heating and cooling will, in the years to come, continue to materially improve their competitive position over fuel systems that are now in general use.

The equivalent energy costs, however, are not the only determining factors for public acceptance of electric heat. The delivered cost of the heat at the point of use and the many possible economic reductions in the heating requirements, as well as the several inherent and desirable design and application characteristics of direct electric heat, as shown in Table 2, play an important part in the final selection. The user, for the most part, is interested in the total annual owning and operating cost, including proper credits for the superior inherent design and application characteristics of the heating systems.

Heat Loss and Burning Efficiencies

Usually a fuel heating system, in comparison with electric, is exceedingly limited and inflexible in its application. For instance, the fuel system, for safety reasons, must generally be remotely located from the heated space since a flame is ever present and a vent is always necessary. This necessitates an indirect system which means that the fuel heats a fluid (air, water or steam) which in turn is circulated to the space to be heated. As a consequence, the losses in this transfer of heat from one medium to another must all be charged to the annual energy consumption of a fuel system, including (1) heat wasted up the stack and to the unoccupied areas, (2) the standby and combustion losses, and (3) the adverse effect caused by the depreciation and corrosion of the equipment. Many engineers use the so-called boiler efficiencies, given in the manufacturers' catalogs, for making comparative operating cost analyses and, as a result, their fuel consumption estimates are often too low and misleading.

This catalog efficiency, which in reality is a "boiler test efficiency" under controlled conditions, will seldom, if ever, be obtained on actual installations. There is a significant difference between boiler test efficiency and the desired seasonal efficiency. To obtain this test efficiency, the boiler is cleaned on both the fire side and the water side before it is put on a predetermined load (usually its rated capacity) and operated for at least 24 hours before taking readings. During this warm-up period, the air-fuel ratio is adjusted to give maximum efficiency. It is apparent that such tests do not simulate actual operating conditions throughout the season, since such influencing factors as the standby and distribution system losses, previously mentioned, together with the possible faulty operation of the boiler, have been excluded. It is for this reason that the actual seasonal efficiency, which should be used in annual operating cost evaluation, will be much lower than the 70 to 80% ideal test efficiency usually given in the manufacturers' catalogs for fuel burning package boilers.

Insulation

In many comfort heating systems, particularly when using electric heating, the resulting reduction in both the initial and the annual energy cost, is sufficient economic justification to incorporate and make full use of the many available heat saving devices. Perhaps the most attractive of all these possibilities is the use of thermal insulation to not only reduce the heat loss in the winter but to also materially reduce the summer heat gain with a corresponding reduction in the size of the heating and cooling equipment.

Insulation with proper vapor barrier is, therefore, always strongly recommended in the sidewall, ceiling and floor of an electrically heated structure. Windows and doors should, at least, be weather-stripped and properly caulked and, in most areas of the country, storm windows and doors, or the equivalent, can be easily justified.

Another benefit from insulation, in addition to the saving in operating cost which unfortunately cannot be measured in dollars, is the improvement in the indoor comfort and satisfaction due to the warmer walls and interior surfaces.

The most practical thickness of insulation will depend, to a considerable extent, on the type of structure and on the geographic area. Just recently, the Association of Insulating Manufacturers, together with the electric utilities and other interested groups, have prepared recommendations of insulating practices and procedures which will soon be available as a guide to the entire industry.

Insulation, of course, can be used irrespective of the type of heating system employed. Generally, however, considerably more insulation can be economically justified with electric heating than with fossil fuel systems. This additional insulation does not necessarily penalize the electric system, because the lower initial cost of electric heating will frequently more than offset the cost of additional insulation. Therefore, the electric installation is still in a favorable first cost position and, at the same time, the energy cost for electric heat will be made more competitive with fuel systems.

It must be kept in mind that adding thermal insulation, storm windows and weather-stripping to a residence, in addition to reducing the conduction heat loss, also materially lowers the outdoor air infiltration rate. This in turn tends to increase the indoor humidity levels due to cooking, bathing, laundering, dish washing, and other normal living habits. In fact, unless proper preventative precautions are taken, these appliances can add as much as 6.5 gallons of water a day to a residence with the accompanying excessive relative humidities. One common remedy is to vent the moisture producing appliances to the outside. This method is not too economical, since an equal quantity of outdoor air, with the accompanying dirt and other impurities contained in the atmosphere, must be introduced into the residence with a corresponding increase in the cleaning, heating and cooling requirements. The more acceptable and satisfactory solution is to incorporate a dehumidifier-filter-odor removing unit as part of the heating and cooling system. This can generally

TABLE 2 — DESIGN AND APPLICATION CHARACTERISTICS OF ELECTRIC HEATING WHICH SHOULD BE CONSIDERED IN AN OWNING AND OPERATING COST EVALUATION

(1) FIRST COST. The equipment is frequently more economical to install than competitive fuels and the resulting savings will offset, to a considerable extent, the additional cost of insulation used to reduce the structure heat loss.

(2) INFILTRATION AIR. The additional insulation, generally used, results in a tighter building construction with a corresponding reduction in outdoor infiltration air and an increase in humidity level. Further reduction is realized by eliminating the needed outdoor air to support combustion of fuel boilers.

(3) BOILERS, BOILER ROOM AND CHIMNEY. This equipment, along with circulating pumps, heat exchangers, connecting water and steam piping, and other accessories used with fuel burning equipment, are eliminated from the premises.

(4) SAFETY—QUIETNESS. No danger of violent failures, asphyxiation from carbon monoxide and other gases, and no fuel leakage or improper adjustment. The combustion noise and vibration are also eliminated.

(5) CLEANLINESS—HEALTHFULNESS. All kinds of oily film residue, flue deposits, smoke, flame and fumes are eliminated. Cleaning costs, janitor expenses, painting costs, housekeeping chores can be drastically reduced.

(6) COMFORT—FLEXIBILITY. Heat only when and where needed. Each room or space heated independently with own thermostat to give accurate control, regardless of location. Such flexibility in any other type of system is more costly because of expensive controls, motor valves, etc. Room may be added in future without expensive heating plant expansion.

(7) BUILDING COST. Eliminating of boiler, fuel storage facilities, chimney, auxiliaries, and in many cases an extra building, saves floor space and reduces construction cost, particularly in commercial installations.

(8) MAINTENANCE AND SERVICE. Service labors and operating difficulties usually are materially reduced. No boiler or pump replacements. Eliminates possible freeze-ups from possible boiler breakdowns. Services of operating engineers, required in some areas, are no longer needed.

(9) HEAT LOSSES FROM DISTRIBUTION SYSTEM. Generating the heat at the point of use eliminates extensive loss of heat energy through trenches, piping and ductwork. No energy wasted during off-cycle and no standby losses. Steam or hot water circulation is eliminated along with accompanying heat loss through piping.

(10) SUMMER AIR CONDITIONING. The electric power facilities are suitable for summer air conditioning. Either central system or unit conditioner readily adaptable.

(11) PARTIAL LOAD. Operating cost of equipment remains constant, even at partial load in contrast to fuel fired equipment.

(12) LONGER LIFE. Lack of corrosion and wearing out of parts extends the life of the major equipment to that of the building.

(13) FUEL PRICES. Fuel prices have been and will continue to increase, in some areas at a very rapid and consistent rate, while electricity is holding firm.

be a small, self-contained, independent, forced circulation type of unit, located in the vicinity of the moisture producing appliance.

Such a unit is very practical, since the dehumidifier removes the excess moisture and, at the same time, returns the latent heat of vaporization to the space in the form of useful heat. The filter and the odor absorber, on the other hand, maintain a clean and odor pure environment. In this way, electric heating systems can control, simultaneously, the temperature, humidity, cleanliness and distribution, and thus overcome one of the criticisms sometimes directed toward the in-the-space type of electric heating units.

Cost of Excessive Ventilation Air

Another worth-while reduction can frequently be realized in the heating and cooling requirements of a structure, irrespective of the type of heating system, by the proper selection of the ventilation air quantities.

Interestingly enough, the commonly used ventilation air quantities are not governed by the oxygen requirements or the carbon dioxide liberated, which for normal activity, are about 0.89 and 0.74 cu ft per man-hour, respectively; but instead by the odors rising from occupancy, living habits, smoking, or other such sources. The reduction or control of these odors are generally attempted by introducing air in sufficient quantities to dilute the odor concentration to a non-objectionable level. Such odor free air may be outdoor air, but the more preferable and positive way is to employ odor absorbing materials.

Unfortunately, there are no generally accepted procedures for predetermining the correct amount of ventilation air for any given application and, consequently, the amount selected in many instances depends upon the individual experience and preference of the design engineer. The ventilation air requirements for human occupancy are a function of the space per person and the activity, as shown by Fig. 4*. Some minimum outdoor requirements (during the heating season), established back in 1936 under laboratory conditions and shown as curve *C* of the figure, vary from 8 cfm per person when occupying a volume of 400 cu. ft. to 25 cfm per person with 100 cu ft of space. In contrast, present day practice indicates ventilation air quantities, during the cooling cycle, of 15 cfm per person with a minimum of 10 cfm for general office areas, with some smoking. For private offices with no smoking, the recommended figures increase to 25 cfm per person, and with considerable smoking to 30 cfm or 0.25 cfm per sq ft of floor area, whichever is the greater.

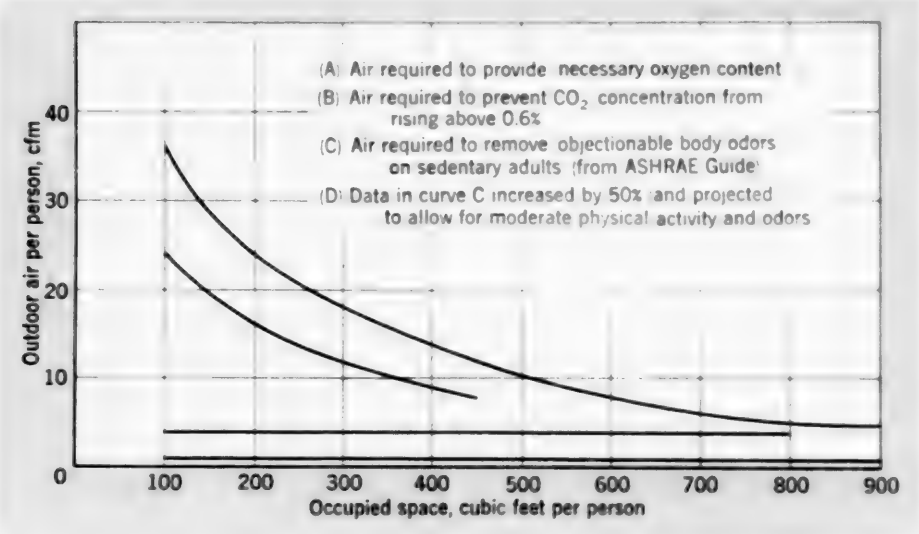

Fig. 4. Ventilation requirements related to cubic feet of occupied space per person.

This rule of thumb method disregards the available cubic foot of space per person (which is related to the ventilation requirements, as shown by Fig. 4) and thereby frequently results in excessive ventilation air. Even so, some design engineers work on the theory that, if 15-30 cfm per person, for instance, is accepted practice, then 40-60 cfm will be better. There are no available data, however, which indicate more healthy and acceptable conditions will result with increased air quantities and actually there is no factual information to indicate an adverse effect, if the quantities are reduced. It does appear to be axiomatic, therefore, that reasonable ventilation quantities, without sacrificing a healthful environment, should be selected in order to obtain a minimum first cost and operating cost.

In fact, even minimum quantities of outdoor air

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* From Cause and Control of Odor in Air Conditioned Spaces, by Warren Viessman, *Air Conditioning, Heating and Ventilating*, September, 1959.

may be unacceptable, because of the objectionable, irritable and toxic odors in the atmosphere due to a high percentage of hydrogen sulphide, smog, and other chemical effluence from industrial processes. It is because of this possibility that physical or chemical odor removal units are increasing in popularity.

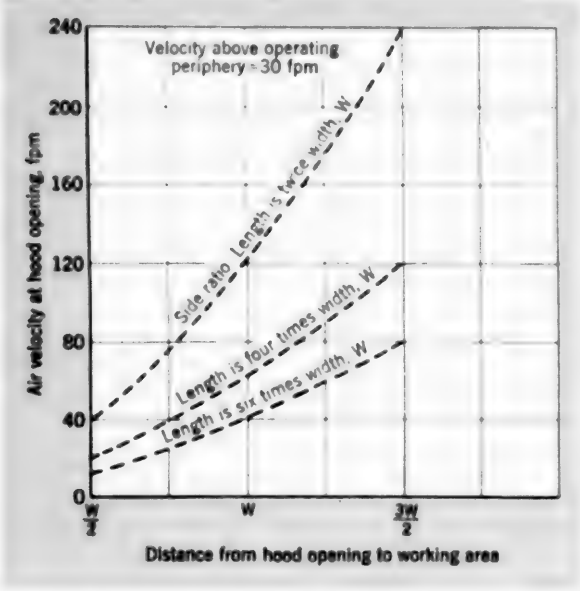


Fig. 5. Relation between air velocity at hood opening and distance to working surface for rectangular hoods.

It has been found, for instance, that an absorbing material, such as activated charcoal together with a conventional air filter or an electric filter, is quite effective in removing tobacco smoke and other such odor causing substances. Using such a unit, along with a minimum amount of outdoor air in a year-round air conditioning system, can be very practical and will frequently show an attractive saving in both first cost and operating cost over a system using just the larger quantities of outdoor air.

Ventilation for Kitchen and Industrial Processes

Many excellent examples of excessive outdoor air usage can be found in commercial and industrial applications. In many instances, ventilation air quantities for kitchens and industrial applications are enormous and frequently the heat required to temper the air will exceed all of the other heat losses of the structure. Fortunately, there are several practical and attractive methods for achieving considerable savings, including:

1. Injecting untempered supply air into hot areas or over hot equipment, so as to pick up the heat without causing uncomfortable working conditions.
2. Heating the supply air with waste gases or hot discharged air by means of a heat exchanger.
3. Employing vented hoods over heat producing equipment.

Perhaps the third suggestion, of employing vented hoods to reduce the ventilation requirements, offers the most attractive possibilities for the normal type of commercial or industrial application. Attractive and structural acceptable hoods are frequently used in hotel and restaurant kitchens, for instance, but relatively little information is available on effective methods for entraining and exhausting the fumes from localized areas with a minimum consumption of room air. Carelessness and over liberal designs of hoods, not only result in fantastic ventilating air requirements with the corresponding high initial and operating costs, but create formidable problems of introducing the make-up air in the space. Large hoods require less air per unit volume than smaller ones, as illustrated by Fig. 5. This figure shows the relationship between air velocity at hood opening and distance between hood opening and working surface. It can be noted that the ratio of length to width, as well as the distance above the work surface, effects the required velocity of the hood opening. The curves, in Fig. 5, are based on a 30 fpm velocity above operating periphery.* Velocities below 30 fpm, even as low as 10 fpm, have been found to be adequate if the open areas, not in use, are covered with a suitable metal shield. With these lower periphery velocities, the required air velocity at the hood opening is proportionally reduced. For example, changing the periphery velocity from 30 to 10 fpm, of a hood with a length six times the width and at a height W above working area, will cause a corresponding reduction in the velocity at the hood opening from 40 to 13.4 fpm.

In some instances, unheated outdoor air can be introduced, as shown by Fig. 6, to prevent drafty conditions in the kitchen and, at the same time, to materially reduce the heating requirements. In such an arrangement, it is often feasible to use 65% of the ventilation air directly from the outside and only 35% from the surrounding area.

Off-Peak Storage

Another aspect of electric heating, along with insulation and other heat saving devices which are destined to become more popular and acceptable, is off-peak heat storage. Acceptable forms of heat storage will not only be attractive to the user but will encourage some of the electric utilities to have a heating rate to further improve the competitive position, particularly in the commercial and industrial field. At the present time, water is usually used as a storage medium, particularly in the northeastern section of the country. In this area, approximately 17% of the electric utilities have a night heating rate which averages about 55 to 60% of the day rate. The night rate is usually applicable for 7 to 8 hours, starting around 10 to 11 pm.

* From Design of Kitchen Range Hoods, J. M. DallaValle, *Air Conditioning, Heating and Ventilating*, August, 1953.

There are several other possibilities of off-peak heat storage, in addition to the high temperature water systems, such as the heat of fusion or the heat of vaporization of chemicals, and those employing materials having high specific heat. A form of the specific heat type of storage has been used in Scotland and other parts of England, and several installations are now operating in this country. This system, which employs the concrete floor as the storage medium, in

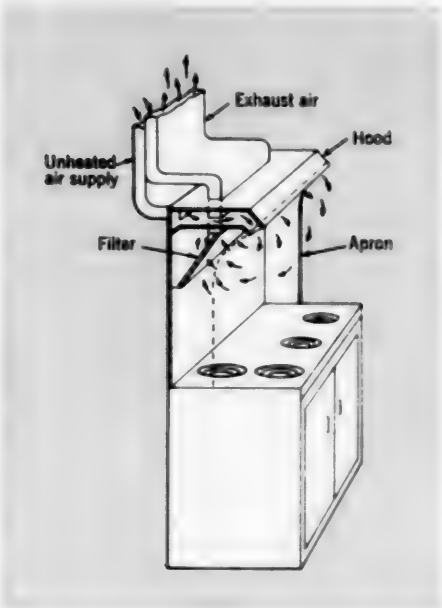


Fig. 6. Suggested method of providing unheated outdoor air for hood ventilation to cut heating and cooling cost.

conjunction with embedded electric heating cable, is particularly attractive for warehouses, storerooms, garages, and similar commercial structures where a 4 or 5 deg F indoor temperature variation is acceptable and where a special reduced electric rate is available during specified off-peak hours. During the permissible charging period, the concrete floor is heated to predetermined temperatures, which are scheduled to change with the outdoor temperature. The floor temperature may vary between 70-75 deg, at mild outdoor temperatures, and be increased to 80 or even 90 deg when extremely cold weather is being experienced.

Field tests have proven that heat stored in the concrete floor will maintain reasonably acceptable temperatures during the 8 to 10 non-charging hours without any excessive drop in surface temperature.

This type of low temperature floor radiant system has a number of design and application advantages. For instance, evenly distributed temperatures are provided, air currents are minimized, and drafts reduced. In addition, the temperature is greatest near the floor and lowest near the ceiling. This is the converse of gravity or forced convection systems which generally have the higher air temperature at the ceiling. Consequently, the conduction heat loss for a floor radiant system should be less than for the convection types of systems. Also, there is some indication that the natural air infiltration rate is lower with low temperature radiant systems, because of the elimination of the thermal head (or chimney) effect which is prevalent in convection heating. Such a system also offers attractive possibilities for the electric utilities to establish off-peak rates which can make electric heating more competitive with any fuel system.

High Temperature Infrared Radiant Systems

Another form of electric heating, finding increasing acceptance in many industrial and commercial comfort heating applications, is the high intensity infrared radiant heating units. In contrast with the low temperature floor radiant systems, which often required utilization of the full floor or ceiling area to obtain sufficient heating effect, the high temperature units emit a much greater quantity of thermal radiation per unit area.

These high temperature units, which resemble fluorescent lighting fixtures, are scientifically designed to enable the long wave infrared rays to pass through cold air and to warm objects which fall within its focused beam. This optically engineered reflector thus insures a maximum radiant effect with a minimum transfer of convection and conduction heat to the ambient. The pure fused quartz tube heating element is a refractory material which can withstand temperatures up to 1800 deg. The quartz envelope resists thermic shock and will withstand ice cold water sprays without damage. Thus, it is suitable for either indoor or outdoor application in the coldest of climates.

High temperature infrared heating can be used for many comfort heating installations, including spot heating in warehouses, machine shops, stadium grandstands, bus stations, theater marquees, barns, churches, railroad stations and repair shops, swimming pool perimeters, iron and steel foundries, and all high bay areas which may be difficult to heat because of possible stratification. This type of heating is particularly applicable for warming workers in open and semi-open areas, such as loading docks or buildings where large doors are frequently opened. Since comfort can be achieved with spot heating, without raising the ambient temperature, a considerable saving in operating cost can result over convection heating. Other advantages, in addition to operating cost, include reduction in cleaning and maintenance cost, ease and economy of the installation, and elimination of obstructions in the working area.

Some experience is essential in designing these installations and the heater manufacturers should be consulted. Consideration should not only be given to the building heat loss, but to the radiant intensity at the working level where the heating is desired. It should be noted that good insulating practices are also beneficial in this type of heating. Loading of 12 to 20

watts per square foot is normally used in a reasonably well-insulated building in continuous use. This intensity is often increased to 30 to 50 watts per square foot for heating the perimeter of the building or localized work areas.

Domestic Electric Water Heating

Another example of the savings, which can be gained by taking full advantage of electricity's ability to generate the heat when and where needed, is demonstrated by domestic water heating applications.

The traditional approach to supply hot water to each fixture in the building, particularly in commercial and industrial installations, is to use a remotely located boiler with a forced hot water circuit. The water in this loop must be continuously circulated by a fairly substantial size motor driven pump in order to have instantaneous hot water at all times.

This type of installation is relatively high, in both first cost and in operating cost. The first cost is high because both a hot and a cold water line must go to each fixture; high in operating cost, because of the kilowatt-hours consumed by the continuously operated pump and by the heat wasted from the hot water piping. This pipe heat loss is an important consideration since it has been found in some installations to represent 50% of the heat supplied to the water by the central unit. It might be contended by advocates of such a remotely located system that the piping loss is not really wasted, since it goes towards heating the building. This normally is not the case, since the piping is usually located in the interior of the building which seldom requires heating, because of the lighting and other internal gain. In fact, this pipe loss, in many instances, actually contributes to the overheating of the internal areas in the winter period and also adds to the cooling load in the summertime. Of course, in some instances this pipe loss can be reduced by insulation, but this material adds to the already high first cost of the system.

The logical approach for overcoming the disadvantage of the remotely located heating units is to use small individual electric hot water units immediately adjacent to each fixture, similar to that shown by Fig. 7. In such an installation, only the cold water line needs to be installed throughout the building and, consequently, all piping losses and circulating pumps are eliminated. In addition, because of the absence of the piping losses and the nearness of the heater to the fixture, the water temperature can be held at 120 deg F (which is about as hot as the human hand can endure) or even lower, instead of 140 to 160 deg generally used for central systems. Maintaining lower water temperatures in this manner will not only appreciably reduce the energy consumption but also eliminate the corrosiveness of the water which shortens the life of the piping.

Small individual electric units at each fixture, therefore, can show a considerable saving in the annual owning and operating cost over fuel heating, because of the reduction of the piping and other materials combined with the more effective use of the heat. It is to be noted that fuel type domestic water heaters can be either the large remote type boilers, similar to that used for comfort heating, or the so-called flame type units. In any comparative evaluation with electric units, it is essential to give proper consideration to the inefficiencies of these latter types of units. The flame type water heaters are basically more inefficient in operation than even the previously mentioned conventional fuel fired boilers. This is because the open flame, generally applied to the bottom of the tank, causes the sediment and scale (from the water and from the products of combustion) to form an insulating crust which resists the transfer of heat. In contrast, the comparable electric heater has no flame, no scale formation, and no sediment to effect heat transfer, since the heating element is either immersed directly in the water or strapped around the exterior of the tank above the bottom.

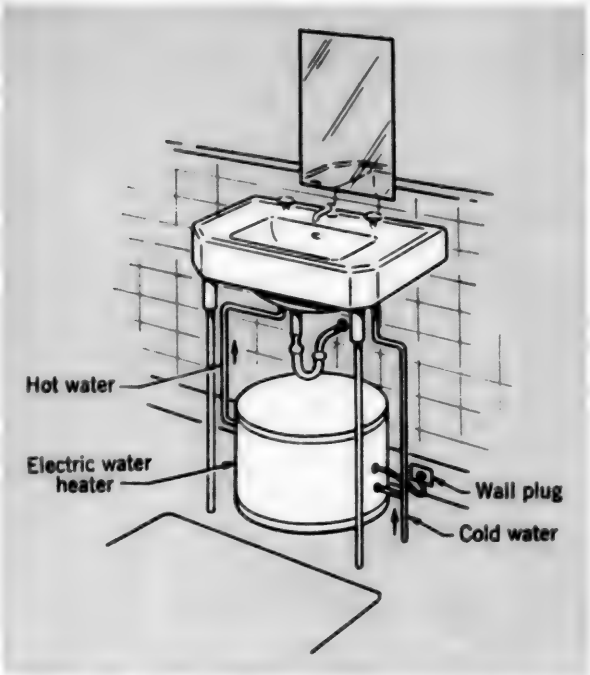


Fig. 7. Small individual electric water heater to eliminate customary hot water line.

School Electric Heating

The economic advantage to be gained by utilizing all possible heat saving procedures and by generating the heat at the point of use is also excellently demonstrated by school heating applications.

Most classrooms are only occupied 7 to 9 hours per day and 5 days per week, which, excluding legal holidays and the extended vacation at Christmas and Easter, represents 20-25% of the school year. During this relatively short period, a 72-75 deg indoor temperature is generally maintained and a predetermined

TABLE 3—ELECTRIC HEATING, KILOWATT-HOURS FOR SEVERAL ELEMENTARY SCHOOLS*

Location of School	Sq Ft Floor Area	Number of Rooms	Calculated Heating Requirements, KW	Actual Seasonal Heating Requirements, KWH	Measured Heat Demand, KW	KW Other Use	Total KW Demand of Heating and Other Uses	KWH Total	Degree-Days '58-'59 Htg. Season
College Corner, Ind. ..	20,326	9	260	187,200	232	55	266	257,854	5,981
Portsmouth, Ohio ...	23,540	13	205	155,520	184	64	225	226,560	4,098
Penn Township, Ind. ...	198,600	50†	2,650	2,495,520	1,581	259	1,685	2,829,600	6,585
Hartford City, Ind.	9,190	5	127	111,600	78	16	84	127,120	6,039
German Township, Ind.	29,300	13	382	424,128	346	83	398	498,240	6,642
South Bend, Ind.	16,270	11	417	252,576	187	52	216	295,884	6,628
Wintersville, Ohio	7,500	5	125	100,167	100	35	120	118,643	5,543
Garner, Kentucky	8,512	5	124	96,840	108	22	119	123,240	4,452

* Schools are located in area served by American Electric Power Co.
† 2-Story Building

amount of ventilation air is used. Even so, the conduction and ventilation air heat loss, during this occupied period, is offset to a considerable extent by the lights, people and solar effect. Generally, no heat at all is needed at outdoor temperatures of about 40 deg or higher and instead some form of cooling must be provided to prevent overheating in the classrooms. In addition, a further reduction in the annual heating requirement can be realized by holding an indoor temperature of 50 to 60 deg during the remaining 75-80%, unoccupied period, of the school year.

With such widely variable heating loads, the design capacity of the system is very seldom required and actually most of the time only 25% or even less of the rated capacity is needed. Fuel fired units remotely located in a boiler room and connected to a network of hot water or steam piping, with the accompanying high standby losses from the boiler, from the stack, and from the piping, will result in an exceedingly low overall seasonal operating efficiency.

In contrast, the electric heating units, located within the classrooms, will not only eliminate all such losses and inefficiencies but in addition can often be installed at a lower initial cost. It is important to remember, however, that the main objective in the design of electric heating systems is not just the lower first cost but a lower annual owning and operating cost, by taking full advantage of all of the application and operating characteristics, as outlined in Table 2. A definite outline, such as given by Fig. 2, is very helpful in making this annual cost evaluation, in order to make certain that proper credit is given to all such items as saving in floor space, reduction in maintenance and service expenses.

For electricity to have maximum advantage over competitive systems, the school building must be designed and erected to make use of all possible heat saving procedures, such as recommended insulation, adequate but not excessive ventilation requirements, and accurate operating controls for full utilization of all the inherent characteristics of electric heating. Actually, impressive savings can be realized in the heating system and even more in the structure, since the architect or consulting engineer need no longer be concerned with the boiler room, chimneys, piping, trenches, crawl spaces, and associated physical and mechanical considerations of conventional wet heat systems. The building can literally be designed around the extraordinary flexibility of the electric system. Just to substitute electric heating for a steam or hot water boiler in a given building, is certainly not the proper procedure and, if followed, will frequently be disappointing in both initial cost and operating cost.

Design Factors

There has been some acceptance of electric heat for schools as demonstrated by the more than 230 electrically heated schools already completed or under construction. Some of the design and operating factors of a few of these installations, which have been operating for a year or more on the American Electric Power Company system, are given in Table 3. It is to be noted that the operating cost is quite variable, depending upon the type of building, amount of ventilation (which can account for 40-50% of the heating requirements), and all of the other factors previously mentioned. Any comparison, therefore, of the heating Btu's with fuel heating systems or even with other electric systems on a square foot or cubic foot basis, can be and usually will be very misleading. Such operating data, as given in Table 3 can be beneficial in determining the constants which are applicable to the standard heating formulas generally used for predicting the annual energy consumption.

FLOW OF WATER IN CIRCULAR SEWERS

Continued from June. Table by J. Nashbar, associate, Albert Kahn Associated Architects and Engineers, Detroit, Mich.

Pipe ID, Inches	Slope of the Hydraulic Grade Line, Ft per Ft								Pipe ID, Inches
	.015		.016		.017		.018		
	V = Mean Flow Velocity, Ft per Sec, Q = Flow Capacity, Cu Ft per Sec								
	V	Q	V	Q	V	Q	V	Q	
4	2.2	.19	2.3	.20	2.4	.21	2.4	.21	4
5	2.7	.36	2.7	.38	2.8	.39	2.9	.40	5
6	3.1	.61	3.2	.63	3.3	.65	3.4	.67	6
8	3.9	1.36	4.0	1.40	4.1	1.44	4.3	1.49	8
10	4.6	2.5	4.8	2.6	4.9	2.7	5.1	2.8	10
12	5.3	4.2	5.5	4.3	5.7	4.4	5.8	4.6	12
15	6.3	7.7	6.5	8.0	6.7	8.2	6.9	8.4	15
18	7.2	12.7	7.4	13.1	7.7	13.5	7.9	13.9	18
21	8.0	19.4	8.3	20.0	8.6	20.6	8.8	21.2	21
24	8.9	27.9	9.2	28.8	9.4	29.7	9.7	30.5	24
27	9.6	38.3	10.0	39.6	10.3	40.8	10.6	42.0	27
30	10.4	51	10.7	52.7	11.1	54	11.4	56	30
36	11.8	83	12.2	86.2	12.6	89	12.9	91	36
42	13.1	126	13.5	130	14.0	134	14.4	138	42
48	14.4	181	14.8	187	15.3	192	15.7	198	48
54	15.6	247	16.1	256	16.6	263	17.0	271	54
60	16.7	328	17.2	338	17.8	349	18.3	359	60
66	17.8	422	18.4	436	18.9	450	19.5	463	66
72	18.8	532	19.4	550	20.0	566	20.6	583	72
78	19.8	658	20.5	679	—	—	—	—	78
84	20.8	801	—	—	—	—	—	—	84
90	—	—	—	—	—	—	—	—	90
96	—	—	—	—	—	—	—	—	96

Pipe ID	Slope of the Hydraulic Grade Line, Ft per Ft								Pipe ID
	.019		.020		.022		.024		
	V	Q	V	Q	V	Q	V	Q	
4	2.5	.22	2.6	.22	2.7	.24	2.8	.25	4
5	3.0	.41	3.1	.42	3.2	.44	3.4	.46	5
6	3.5	.68	3.6	.70	3.7	.74	3.9	.77	6
8	4.4	1.53	4.5	1.57	4.7	1.64	4.9	1.72	8
10	5.2	2.8	5.3	2.9	5.6	3.0	5.8	3.2	10
12	6.0	4.7	6.1	4.8	6.4	5.1	6.7	5.3	12
15	7.1	8.7	7.3	8.9	7.6	9.3	8.0	9.8	15
18	8.1	14.3	8.3	14.7	8.7	15.4	9.1	16.1	18
21	9.1	21.8	9.3	22.4	9.8	23.5	10.2	24.5	21
24	10.0	31.4	10.2	32.2	10.7	33.7	11.2	35.2	24
27	10.9	43.2	11.1	44.3	11.7	46.5	12.2	48.5	27
30	11.7	57	12.0	59	12.6	62	13.1	65	30
36	13.3	94	13.6	96	14.3	101	14.9	106	36
42	14.8	142	15.2	146	15.9	153	16.6	160	42
48	16.2	203	16.6	209	17.4	219	18.2	228	48
54	17.5	279	18.0	286	18.8	300	19.7	313	54
60	18.8	369	19.3	378	20.2	397	—	—	60
66	20.0	475	20.5	488	—	—	—	—	66
72	—	—	—	—	—	—	—	—	72
78	—	—	—	—	—	—	—	—	78
84	—	—	—	—	—	—	—	—	84
90	—	—	—	—	—	—	—	—	90
96	—	—	—	—	—	—	—	—	96

FLOW OF WATER IN CIRCULAR SEWERS

Pipe ID, Inches	Slope of the Hydraulic Grade Line, Ft per Ft								Pipe ID, Inches
	.026		.028		.030		.032		
	V = Mean Flow Velocity, Ft per Sec, Q = Flow Capacity, Cu Ft per Sec								
	V	Q	V	Q	V	Q	V	Q	
4	2.9	.26	3.0	.27	3.1	.27	3.2	.28	4
5	3.5	.48	3.6	.50	3.8	.51	3.9	.53	5
6	4.1	.80	4.2	.83	4.4	.86	4.5	.89	6
8	5.1	1.79	5.3	1.85	5.5	1.92	5.7	1.98	8
10	6.1	3.3	6.3	3.4	6.5	3.6	6.7	3.7	10
12	7.0	5.5	7.3	5.7	7.5	5.9	7.8	6.1	12
15	8.3	10.2	8.6	10.5	8.9	10.9	9.2	11.3	15
18	9.5	16.7	9.8	17.4	10.2	18.0	10.5	18.6	18
21	10.6	25.5	11.0	26.5	11.4	27.4	11.8	28.3	21
24	11.7	36.7	12.1	38.1	12.5	39.4	13.0	40.7	24
27	12.7	51	13.2	41.4	13.6	54	14.1	56	27
30	13.7	67	14.2	70	14.7	72	15.2	75	30
36	15.5	110	16.1	114	16.7	118	17.2	122	36
42	17.3	166	17.9	173	18.6	179	19.2	184	42
48	18.9	238	19.6	247	20.3	255	—	—	48
54	20.5	326	—	—	—	—	—	—	54

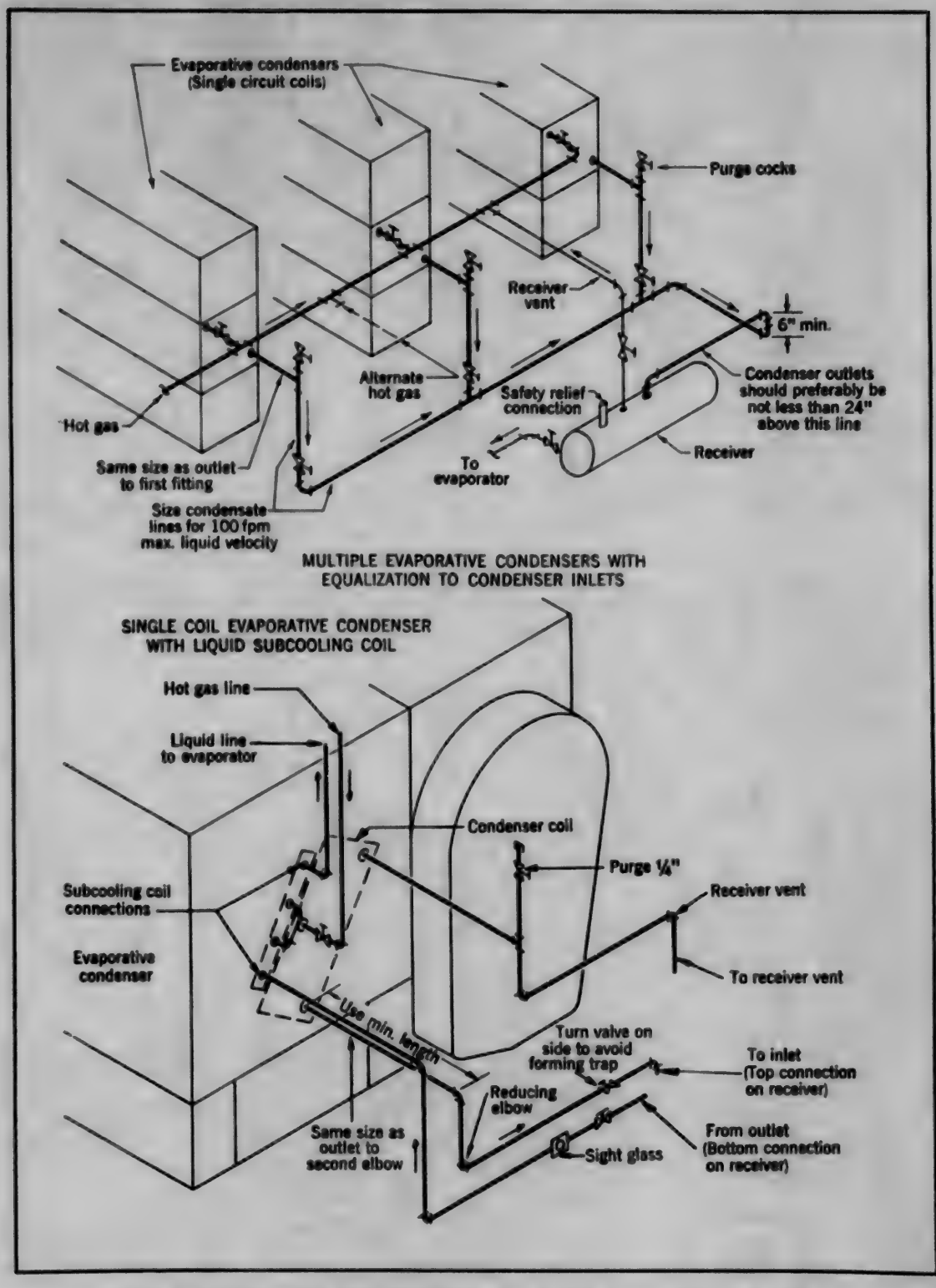
Pipe ID	.034		.036		.038		.040		Pipe ID
	V	Q	V	Q	V	Q	V	Q	
4	3.3	.29	3.4	.30	3.5	.31	3.6	.32	4
5	4.0	.55	4.1	.56	4.2	.58	4.4	.60	5
6	4.7	.91	4.8	.94	4.9	.97	5.1	.99	6
8	5.8	2.0	6.0	2.1	6.2	2.2	6.3	2.2	8
10	7.0	3.8	7.2	3.9	7.4	4.0	7.5	4.1	10
12	8.0	6.3	8.2	6.5	8.5	6.6	8.7	6.8	12
15	9.5	11.6	9.7	12.0	10.0	12.3	10.3	12.6	15
18	10.8	19.1	11.1	19.7	11.5	20.2	11.8	20.8	18
21	12.1	29.2	12.5	30.0	12.8	30.8	13.2	31.6	21
24	13.4	42.0	13.7	43.2	14.1	44.4	14.5	45.5	24
27	14.5	58	14.9	59	15.4	61	15.8	62.7	27
30	15.6	77	16.1	79	16.5	81	17.0	83	30
36	17.8	126	18.3	129	18.8	133	19.3	136	36
42	19.8	190	20.3	196	20.9	201	—	—	42

Pipe ID	.042		.044		.046		.048		Pipe ID
	V	Q	V	Q	V	Q	V	Q	
4	3.7	.33	3.8	.33	3.9	.34	4.0	.35	4
5	4.5	.61	4.6	.62	4.7	.64	4.8	.65	5
6	5.2	1.02	5.3	1.04	5.4	1.06	5.5	1.09	6
8	6.5	2.3	6.7	2.3	6.8	2.4	7.0	2.4	8
10	7.7	4.2	7.9	4.3	8.1	4.4	8.3	4.5	10
12	8.9	7.0	9.1	7.1	9.3	7.3	9.5	7.5	12
15	10.5	12.9	10.8	13.2	11.0	13.5	11.3	13.8	15
18	12.0	21.3	12.3	21.8	12.6	22.3	12.9	22.8	18
21	13.5	32.4	13.8	33.2	14.1	33.9	14.4	34.7	21
24	14.8	46.6	15.2	48	15.5	48.8	15.9	49.9	24
27	16.1	64	16.5	66	16.9	67	17.3	69	27
30	17.4	85	17.8	87	18.2	89	18.6	91	30
36	19.8	140	20.2	143	20.7	146	—	—	36

(The table is concluded next month.)

REFRIGERANT PIPING

Hookups for Evaporative Condensers


Evaporative condensers
(Single circuit coils)
Purge cocks
Receiver vent
6" min.
Alternate hot gas
Safety relief connection
Condenser outlets should preferably be not less than 24" above this line
Hot gas
Same size as outlet to first fitting
To evaporator
Receiver
Size condensate lines for 100 fpm max. liquid velocity
MULTIPLE EVAPORATIVE CONDENSERS WITH EQUALIZATION TO CONDENSER INLETS
SINGLE COIL EVAPORATIVE CONDENSER WITH LIQUID SUBCOOLING COIL
Hot gas line
Liquid line to evaporator
Condenser coil
Purge ¼"
Receiver vent
Subcooling coil connections
Evaporative condenser
To receiver vent
Use min. length
Turn valve on side to avoid forming trap
To inlet (Top connection on receiver)
Reducing elbow
Same size as outlet to second elbow
From outlet (Bottom connection on receiver)
Sight glass

REFRIGERANT PIPING

Hookups for Evaporator Installations

Drawings on This and Reverse Page, Courtesy of Carrier Corp., Syracuse, N. Y.

The Engineering Significance of

Normal Atmospheric Pressure

- *How It Varies with Altitude*
- *A Simple Means of Estimation*

Often, the elevation of an air handling system makes a great difference in design calculations. Engineers should know the derivation of so-called "standard" variation of atmospheric pressure and temperature in order to apply values correctly. A multi-pressure air chart is appended.

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IT is well known that atmospheric, or barometric, pressure decreases with altitude. What is less well known, and perhaps may be hazy to many engineers, is: Just *how* does normal atmospheric pressure decrease with altitude, and what is the basis for this decrease?

Before answering this question, it seems that the term "normal atmospheric pressure" should be defined. By "normal" is meant something related to "average." In other words, values of normal atmospheric pressure are intended to be averages, but—what is important here—the term "average" connotes that there is variation. Atmospheric pressure at any given altitude varies with location over the surface of the earth, with vertical temperature distribution, with time, with humidity, and with weather conditions in general. In spite of these known variations, values of normal atmospheric pressure as a function of altitude are needed by the air-conditioning and ventilating engineer, primarily in computations involving air density, in any problem of system design. Additionally, the accurate relation between the moisture content of air and the dry- and wet-bulb temperatures depends on total atmospheric pressure, as do many other psychrometric relations. Thus in use of the ordinary psychrometric chart, corrections are required if atmospheric pressure deviates significantly from the standard sea-level value.

Values of air density are required in computing volumes of air required for combustion, in testing ventilating systems, in computing sensible heat loads, and in evaluating fan performance tests—to list a few examples of the many situations in which knowledge of atmospheric pressure is required. Whenever atmospheric pressure can be measured on the spot, as during a fan performance test or in determining velocity in a ventilating duct with a pitot tube, such should be done. For this purpose, a mercury or aneroid barometer may be used, and the value obtained should be utilized in preference to a normal value. The aneroid barometer is a portable device, and temperature-compensated instruments of good accuracy are available.

But whenever system design is involved, and a figure must be chosen as a basis for calculating operating characteristics, data on normal atmospheric pressure as a function of altitude are a necessary accompaniment. For example, the design of an exhaust system for construction and operation in Denver, at an elevation of about 5,400 ft, may be very similar to the design of a system to be operated at sea level, except that the brake horsepower required by the fan and the static pressure of the system will be in direct proportion to atmospheric pressure or air density. It makes great difference whether a system is designed for use in Chicago, Atlanta, Salt Lake City, or Abilene, Texas —as far as normal atmospheric pressure, air density, and all dependent operating characteristics are concerned—since the elevations (or altitudes) of these cities vary significantly one from another and also from sea level.

The values of normal atmospheric pressure in common use are derived from research conducted by the U. S. Weather Bureau at the request of the National Advisory Committee for Aeronautics (N.A.C.A.). The Bureau examined much long-term weather data of the United States, including atmospheric pressure and temperature, and arrived at the specifications of what is now defined as the U. S. Standard Atmosphere. The specifications are meant to represent average annual conditions over the United States at 40°N latitude, and extend to altitudes much greater than those of

interest in ventilation and air conditioning. The U. S. Standard Atmosphere includes all of the troposphere, which extends to an altitude of 35,332 ft (10.769 kilometers) and is characterized by a constant rate of temperature decrease with altitude, and also the stratosphere characterized by constant temperature. The complete specifications of the U. S. Standard Atmosphere are as follows:

(1) The atmosphere is assumed to be dry and to obey the ideal gas law.

(2) Surface (sea level) temperature is set at 59 deg F (15 deg C) and surface pressure at 29.92 inches (760 millimeters) of mercury.

(3) There is a constant decrease at the rate of 3.566 deg F per 1000 ft (6.5 deg C/km) in atmospheric temperature from sea level to the lower limit of the isothermal atmosphere, the temperature of which is taken to be −67 F (−55 C).

(4) The acceleration of gravity is constant at the standard value of 980.665 cm/sec² (32.1740 ft/sec²). Based on specifications (2) and (3) above, the lower limit of the isothermal atmosphere (stratosphere), or the upper limit of the troposphere, may be calculated to be at 10.769 km (35,332 ft), as stated above. The upper limit of the range of altitudes of interest in air conditioning and ventilation is taken to be on the order of 15,000 ft.

The basic equation of the U. S. Standard Atmosphere applying to the range of constant temperature decrease with altitude may be derived as follows. Considering a mass of air of unit horizontal cross-sectional area and of differential thickness in the vertical, at altitude Z and of density ρ where the acceleration of gravity is g, a vertical force balance results in

$$dP = -g\,\rho\,dZ \tag{1}$$

where dP is the differential of pressure between the top and bottom levels of the mass which are the distance dZ apart. This differential equation is of fundamental importance.

Next, from specification (3), we may write

$$T = T_o - aZ \tag{2}$$

where T is the temperature at altitude Z, T_o is the surface temperature, and a is the constant rate of decrease of temperature with altitude, in consistent units. Thus,

$$t = 59 - 0.003566\,Z \tag{3}$$

where t is in degrees F and Z is in feet, or

$$T = 518.7 - 0.003566\,Z \tag{4}$$

where T is in degrees Rankine, absolute temperature scale ($T = 459.7 + t$) and Z is in feet.

Finally, our third necessary relation is the ideal gas law in the form

$$\rho = \frac{P}{RT} \tag{5}$$

where ρ is the density of dry air at absolute pressure P and absolute temperature T, and R is the gas constant for air. With P in inches of mercury ("Hg) and T in degrees Rankine, for example, ρ will be in lb_m/ft^3 (pounds, mass, per cubic foot) when R has the value 0.7542 ("Hg) $(ft^3)/(deg\ R)\ (lb_m)$.

Combining equations (1) and (5), we get

$$dP = -\frac{gP}{RT}\,dZ. \tag{6}$$

Differentiating (2),

$$dZ = \frac{-dT}{a}. \tag{7}$$

Substituting the value of dZ from equation (7) into equation (6) and re-arranging:

$$\frac{dP}{P} = \left(\frac{g}{aR}\right)\frac{dT}{T} \tag{8}$$

It is seen that equation (8) may be readily integrated, but it should be kept in mind that it applies only with values of absolute temperature for T. Integrating between appropriate limits, we get

$$log_e \frac{P}{P_o} = \left(\frac{g}{aR}\right) log_e \frac{T}{T_o} \tag{9}$$

where P_o and T_o are surface atmospheric pressure and absolute temperature, respectively. Or, in other form,

$$\frac{P}{P_o} = \left(\frac{T}{T_o}\right)^{\frac{g}{aR}} \tag{10}$$

Equation (10) expresses the relation between P, the pressure at any altitude in the troposphere, as a function of the absolute temperature at that altitude, which may be computed by means of equation (2) or (4), and of the standard values of pressure and absolute temperature at sea level. This is the basic equation of the U. S. Standard Atmosphere extending to 35,332 ft and covering all of the range of interest to ventilating engineers. It may be used only with absolute temperatures, but otherwise it is valid for any consistent set of units.

Next, the value of the exponent, g/aR, of the temperature ratio will be evaluated. This value is dimensionless and should be the same regardless of the set of units in which it is computed. In the metric system, accepted and standard values of the quantities that make up this ratio are:

g = 980.665 cm/sec², from specification (4);
a = 0.000065 deg K/cm, from specification (3);
$R = 2.8704 \times 10^6$ ergs/(deg K) (gm) or $(cm^3)/(sec^2)$ (deg K).

Thus,

$$\frac{g}{aR} = \frac{(980.665)}{(0.000065)\,(2.8704 \times 10^6)} = 5.256.$$

In the English system, the following values would prevail:

g = 32.1740 ft/sec²;
a = 0.003566 deg R/ft;
R = 1,716 $ft^2/(sec^2)$ (deg R).

These values give essentially the same value of the exponent, g/aR. Though the units of R, the gas constant for dry air, may seem strange, they may readily be explained. The value of R herein employed is derived from the gas constant for a lb-mol of an ideal gas, which may be expressed as 1,545.0 ft-lb_f/(deg R) (lb-mol). If this value is divided by the apparent molecular weight of dry air, namely 28.966, the value

53.338 ft-lb_f/(deg R) (lb_m) is obtained. This is the value of R that can be used in equation (5) if P is expressed in lb_f/ft^2 (pounds, force, per square foot) and T in degrees R to get ρ in lb_m/ft^3. Then, if this value is multiplied by the conversion constant 32.174 (lb_m) (ft) / (sec^2) (lb_f), the value of 1,716 $ft^2/(sec^2)$ (deg R) is obtained for the gas constant R.

With the value of g/aR worked out, equation (10) may take the form:

$$P = P_o \left(\frac{T}{T_o} \right)^{5.256} \qquad (11)$$

This is the equation used to compute values of normal atmospheric pressure at altitude, based on the U. S. Standard Atmosphere. With P_o given the standard sea-level value of 29.92 "Hg, P also will be in inches of mercury and if T_o is taken as 518.7 deg R, T will have to be in units of deg R and may be computed from equation (4). Standard values of atmospheric pressure and temperature as a function of altitude, as shown in official tables[1,2], are given in Table 1 for altitudes from —1000 ft (1000 ft below sea level) to 15,000 ft in intervals of 500 ft. The values of atmospheric temperature are not of great importance to ventilating engineers but are presented as a matter of interest.

TABLE 1 — STANDARD VALUES OF ATMOSPHERIC PRESSURE AND TEMPERATURE AS A FUNCTION OF ALTITUDE

(Based on the United States Standard Atmosphere)

Altitude above Sea Level, Ft	Atmospheric Pressure, Inches Mercury	Atmospheric Temperature, Deg F
—1000	31.02	62.6
— 500	30.47	60.8
0	29.92	59.0
500	29.38	57.2
1,000	28.86	55.4
1,500	28.33	53.7
2,000	27.82	51.9
2,500	27.31	50.1
3,000	26.81	48.3
3,500	26.32	46.6
4,000	25.84	44.7
4,500	25.36	43.0
5,000	24.89	41.2
5,500	24.43	39.4
6,000	23.98	37.6
6,500	23.53	35.8
7,000	23.09	34.0
7,500	22.65	32.3
8,000	22.22	30.5
8,500	21.80	28.7
9,000	21.38	26.9
9,500	20.98	25.1
10,000	20.58	23.3
10,500	20.18	21.6
11,000	19.79	19.8
11,500	19.40	18.0
12,000	19.03	16.2
12,500	18.65	14.4
13,000	18.29	12.6
13,500	17.93	10.9
14,000	17.57	9.1
14,500	17.22	7.3
15,000	16.88	5.5

Here it may be well to emphasize the great dependence of the relation of atmospheric pressure to altitude on vertical distribution of temperature. Equations (10) and (11) hold only for constant lapse rate (i.e., constant temperature decrease with altitude), and for the latter equation, this rate has been set at 6.5 deg C/km. If the lapse rate of temperature is not constant, different relations may be developed, depending on what relation between atmospheric temperature and altitude is assumed to hold. For the situation of constant temperature with altitude, the form of the equation that may be developed is different from that of equation (10), and in this case the decrease of atmospheric pressure with altitude is not quite so rapid as for a lapse rate of 6.5 deg C/km (if the constant temperature is taken to be the surface temperature as in the U. S. Standard Atmosphere). In general, the greater the lapse rate of temperature, the greater will be the compensation of temperature on decreasing *air density* due to reduced pressure at altitude, and the *more rapid* will pressure decrease with altitude. Thus, for a lapse rate greater than the normal of 6.5 deg C/km, such as 10 or 15 deg C/km, atmospheric pressure will decrease somewhat more rapidly with altitude than it does in the U. S. Standard Atmosphere, due to the fact that the density does not decrease so rapidly. Equation (1) shows that dP/dZ depends directly on air density.

A graph of normal atmospheric pressure versus altitude shows (as in Fig. 1) that as altitude increases, atmospheric pressure decreases, but at a decreasing rate. For example, at sea level, this rate ($-dP/dZ$) is 0.0765 lb_f/ft^2 per foot (0.108 "Hg/100 ft), at 5,000 ft it is 0.0659 lb_f/ft^2 per foot (0.093 "Hg/100 ft), while at 15,000 ft the rate is 0.0481 lb_f/ft^2 per foot (0.068 "Hg/100 ft). This very gradual reduction in the rate at which atmospheric pressure decreases with altitude results in a line of very gentle curvature in the relation of P to Z.

An additional point should be noted here. In arriving at the standard values of atmospheric pressure as contained in official tables (from which Table 1 is taken), absolute temperature in degrees R was computed on the basis of adding 459.4 to the temperature in degrees F rather than by adding the more exact value of 459.7 as is indicated by equation (4). This was done to make the values of absolute temperature in deg R correspond exactly with the values of absolute temperature on the Kelvin scale (deg K), which latter values were computed by adding exactly 273 to the temperature in deg C. This makes little difference in resulting values of pressure. Were the tables recalculated today, probably they would be based on the more exact computation of absolute temperature.

As simple but reasonably accurate approximations to the relation between normal atmospheric pressure and altitude, as expressed in equation (11), the writer

[1] Altitude-Pressure Tables Based on the United States Standard Atmosphere, W. G. Brombacher, *National Advisory Committee for Aeronautics*, Report No. 538, 1935.

[2] Standard Atmosphere—Tables and Data, W. S. Diehl, *National Advisory Committee for Aeronautics*, Report No. 218, 1925.

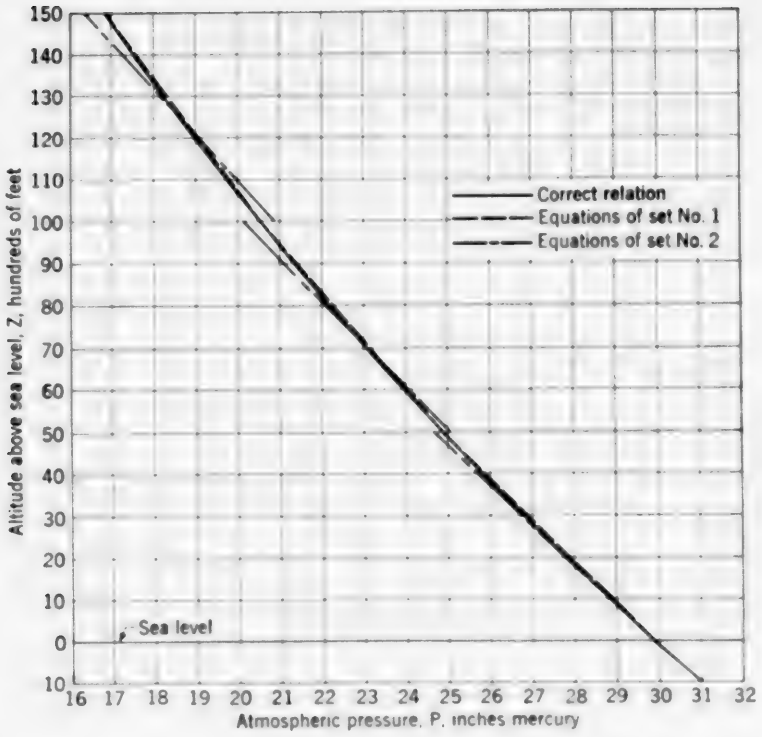


Fig. 1. Normal atmospheric pressure vs. altitude above sea level. A comparison of correct relation, based on the U. S. Standard Atmosphere with simplified linear equations of Table 2.

has developed two sets of equations. Either set consists of three equations, each of which is applicable to a specified range of altitude. All of the equations represent straight lines and are simple to use. They express atmospheric pressure, P, in *inches mercury* as a direct function of altitude above sea level, Z, in *hundreds of feet*. Their use does not require any computations of atmospheric temperature versus altitude and eliminates need for a fractional-power formula. The two sets of equations are presented in Table 2.

The equations of Set No. 1 represent straight lines each of which passes through the end points of the curve of P versus Z for its applicable altitude range. These equations are accurate to within 0.5% over the entire altitude range to 15,000 ft, as may be seen by reference to the *Maximum Error* column of Table 2. For each equation, error has been calculated at a number of altitudes as a percent of the correct value of atmospheric pressure at that altitude (as based on equation (11) or Table 1). For the equations of Set No. 1, maximum error as a percent occurs approximately at the mid-point of each altitude range.

The equations of Set No. 2 are even simpler in form, in that the only value of atmospheric pressure contained explicitly is the standard value for sea level, 29.92 "Hg. Also, it may be seen that these equations have the general form

$$P = 29.92 - bZ,$$

and that the values of b differ between adjacent equations by the constant value of 0.007 "Hg/100 ft. Thus this second set of equations may be easily put to memory by those desiring to do so. Yet these equations are accurate to within 1% for the 0-5,000 ft range, to within 2% for the 5,000-10,000 ft range, and to within 3% for the 10,000-15,000 ft range. Maximum error as shown in Table 2 for each equation occurs at the upper end of the altitude range. Each equation of Set No. 2 represents a straight line passing through the point of sea-level pressure (29.92 "Hg, 0 ft) and through the P versus Z curve at the mid-point of the applicable altitude range. For example, the equation for the 5,000-10,000 ft range represents a straight line passing through the point of sea-level pressure (29.92 "Hg, 0 ft) and also through the point of pressure at 7,500 ft altitude (22.65 "Hg, 7500 ft), but the equation is applicable only over the range of 5,000-10,000 ft. At altitudes of exactly 5,000 and 10,000 ft, P may be computed with either of the two equations of the adjacent ranges with about equal accuracy (within 1% at 5,000 ft and within 2% at 10,000 ft).

For depths below sea-level, the first equation (0-5,000 ft altitude range) of Set No. 2 may be used with good accuracy. At —1,000 ft, the error is only 0.19%.

In Fig. 1 are shown the curve of the correct relation of P versus Z as based on the U. S. Standard Atmosphere equation (11), Table 1, and also the straight lines represented by the equations of Sets No. 1 and 2. Here the P versus Z curve is a relatively heavy, solid

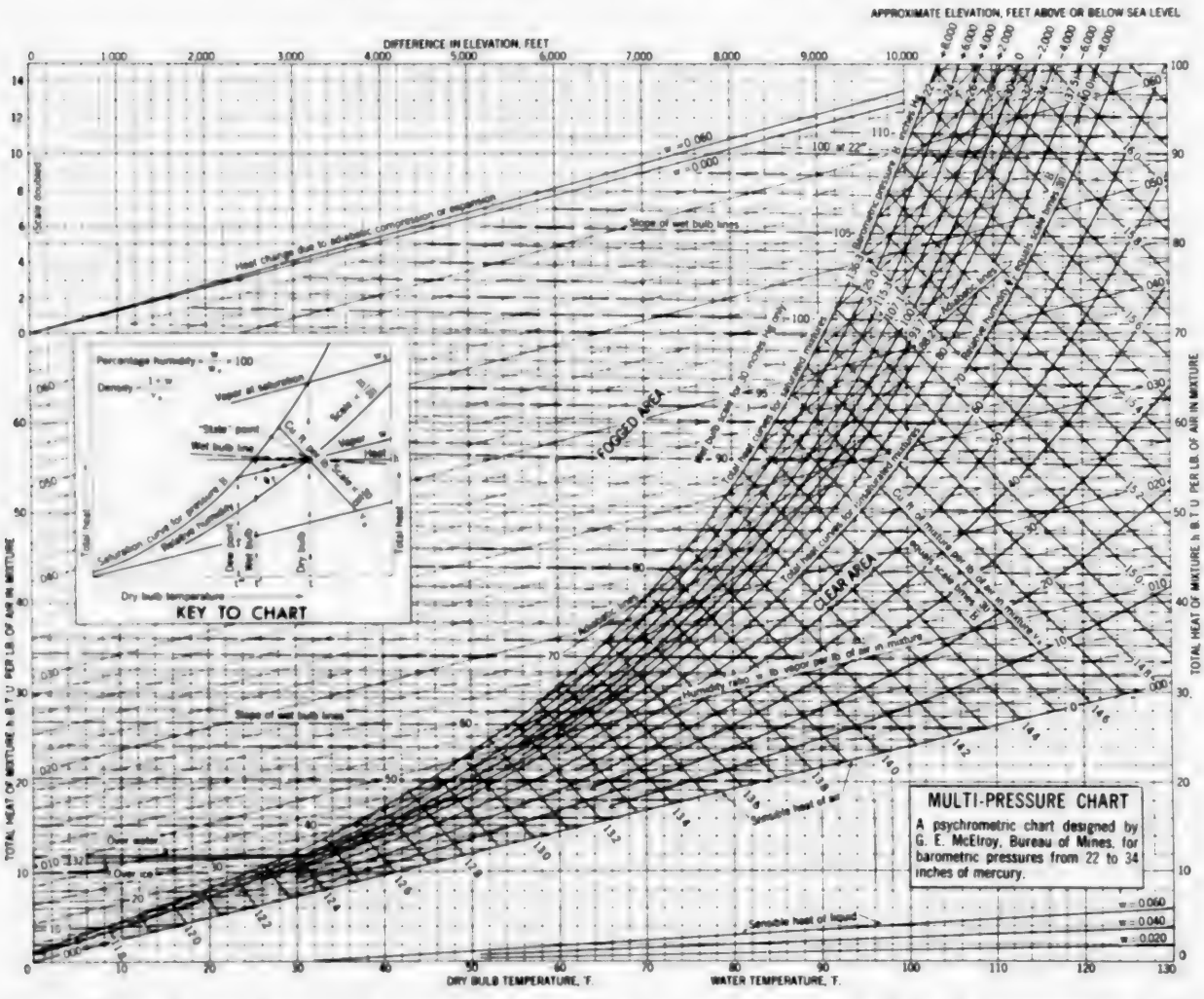
TABLE 2 — LINEAR EQUATIONS RELATING NORMAL ATMOSPHERIC PRESSURE TO ALTITUDE

Altitude Range, Feet	Equation	Maximum Error, Percent
	Set No. 1	
0- 5,000	P=29.92—0.101 Z	0.30
5,000-10,000	P=24.89—0.086 (Z-50)	0.41
10,000-15,000	P=20.58—0.074 (Z-100)	0.43
	Set No. 2	
0- 5,000	P=29.92—0.104 Z	0.68
5,000-10,000	P=29.92—0.097 Z	1.75
10,000-15,000	P=29.92—0.090 Z	2.73

Note: Atmospheric pressure, *P*, is in *inches mercury* when altitude, *Z*, is in *hundreds of feet*.

line. The lines of the equations of Set No. 1, shown as even dashes, lie on the concave (right-hand) side of the curve, while those of the equations of Set No. 2, shown as alternately short and long dashes, cross this curve at altitudes of 2,500, 7,500, and 12,500 ft. In the lowest altitude range, 0-5,000 ft, both straight lines lie very close to the curve, and from 0 to 2,500 ft there is crowding which cannot be avoided.

MULTI-PRESSURE PSYCHROMETRIC CHART


APPROXIMATE ELEVATION, FEET ABOVE OR BELOW SEA LEVEL
DIFFERENCE IN ELEVATION, FEET
KEY TO CHART
FOGGED AREA
CLEAR AREA
MULTI-PRESSURE CHART
A psychrometric chart designed by G. E. McElroy, Bureau of Mines, for barometric pressures from 22 to 34 inches of mercury.
DRY BULB TEMPERATURE, °F.
WATER TEMPERATURE, °F.
TOTAL HEAT OF MIXTURE, h, B.T.U. PER LB. OF AIR IN MIXTURE

Air conditions at various barometric pressures and humidity states are shown graphically in the accompanying multi-pressure psychrometric chart which was designed by G. E. McElroy of the U. S. Bureau of Mines and is reproduced here from the Handbook of Air Conditioning, Heating and Ventilating to supplement the foregoing article.

Given: Barometric pressure 27 inches Hg, wet bulb temperature 81 deg, dry bulb temperature 86 deg.

Find: Total heat content, vapor content, dew-point temperature, relative humidity, cubic feet of mixture per pound of air, percentage humidity, and density.

Solution: Follow 81 deg dry bulb line to intersection with saturation curve for 27 inches Hg. Through this point, project a line parallel to nearest wet bulb slope line to intersection with the 86 deg dry bulb line. This intersection is the state point for the air-vapor mixture. It is on the horizontal total heat content ordinate for 47.5 Btu per pound of air. It is also on the humidity-ratio line for 0.0244 pound water per pound of air. A humidity-ratio line passing through the state point intersects the 27-inch saturation curve at the 79.6 dry bulb line, so the dew-point temperature is 79.6. The scale value of the relative humidity curve passing through the state point is 90.0, so the actual relative humidity is 90.0 × 27/30 or 81.0%. The state point is located on the 14.26 cu ft per pound curve, so 14.26 × 30/27 or 15.84 cu ft of mixture contains 1 pound of air. The intersection of the 86-deg dry-bulb line with the 27-inch saturation curve shows the humidity ratio for a saturated mixture to be 0.0303. Dividing the actual humidity ratio of 0.244 by this figure and multiplying by 100, gives the percentage humidity, 80.5%. The density of the mixture is (1+0.0244)/15.84, or 0.0647 lb per cu ft.

Building Structure Substitutes for Ductwork

Wall-to-wall horizontal air distribution consists of the floor, outside wall, wainscoting, and metal sill. (See drawings on next page.)

A 24-STORY OFFICE BUILDING rising in New York City's financial district is attracting attention because of its novel air distribution system and the economical placement of ductwork and mechanical equipment by Sidney W. Barbanel, consulting engineer, Long Island City, N. Y.

In Essence, Simplicity

Two fan rooms supply conditioned air to the 240,000 sq ft building at 66 Beaver Street. One is on the roof in close proximity to the water chiller, thus minimizing chilled water piping. The other is located in space that might otherwise have been wasted. Mr. Barbanel explains that the first-floor height is about 20 ft, to accommodate a bank. For a lobby that is relatively narrow, a 20-ft ceiling would look awkward, anyway. Therefore, he took advantage of that space to accommodate the second fan room that feeds the lower half of the building. The two fan rooms each feed twelve floors, so that the building is initially zoned vertically.

Each fan room feeds laterally into four up-feed, and four down-feed, insulated sheet metal high velocity ducts enclosed in the H-sections of reinforced concrete columns in the four corners of the building. As a result, no floor space is used, and three exposure zones are established, as well as four vertical zones. Interior zones are handled separately.

Wall-to-Wall Plenums

Horizontal distribution consists of the building construction itself. The horizontal ducts are made up of the floor, the outside wall, the inside wainscoting, and a sill. They are continuous along each side of the building on every floor, and are fed from the corners of the building to which they attach. An inside liner guarantees maintenance of pressure.

At the juncture of the riser and the horizontal distribution, a simple egg-crate arrangement prevents the transfer of noise from the riser. The wainscoting is made of gypsum block, set about twelve inches from the outside wall. It is plastered on the outside, painted with a plastic on the inside (or furnished with a metal liner in some parts) to reduce air friction. In the sill, under each window, is a standard constant-pressure-drop attenuator box that permits the room occupant to control, somewhat, the temperature in the room. Automatic control can be added later.

Friction loss in the horizontal distribution is minimal. In reality, there exists an extended plenum, where the high velocity pressure of the risers has been converted to high static pressure. Thus, variation in the output of any single outlet box has little effect on the system as a whole, on the static drop across any other box on that plenum, and hence, on the conditions in any other space.

The system allows movement of partitions anywhere along the perimeter of the building without interfering with the distribution. Since the heating or cooling load is proportional to the perimeter, the heat balance will be maintained no matter where the partitions are located.

Piping at a Minimum

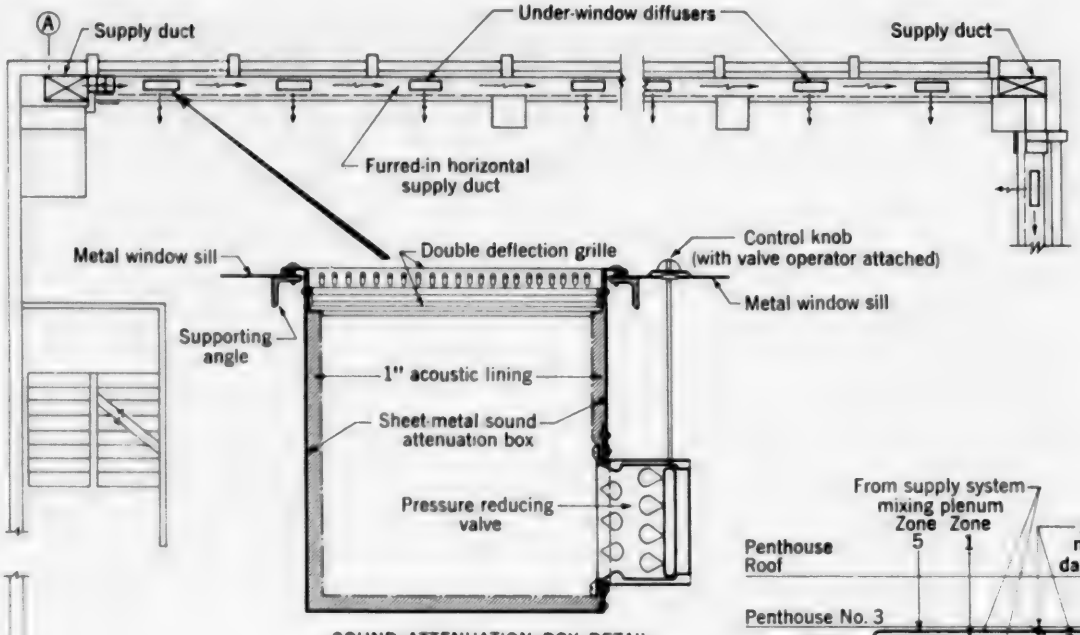
Steam is supplied by a utility from a main in the street. A single upfeed steam line runs to the penthouse, where an absorption machine produces chilled water. The machine, which requires little maintenance and is now available from several manufacturers, though heavy, has no vibration load, making roof installation feasible, and because the absorption machine has a higher heat rejection than a reciprocating or centrifugal compressor, its proximity to the cooling tower happily limits the run of heavy condenser water piping.

The fan-coil units in each fan room have steam coils for reheat control and for tempering outside air and winter heating.

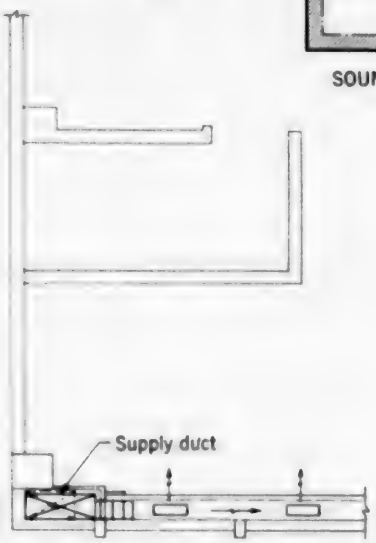
Summary

The refrigeration system for this office building is more or less standard, but placement of the chiller and one fan room on the roof has saved a considerable amount of condenser and chilled water piping. A single steam line feeds the absorption machine and the heating coils.

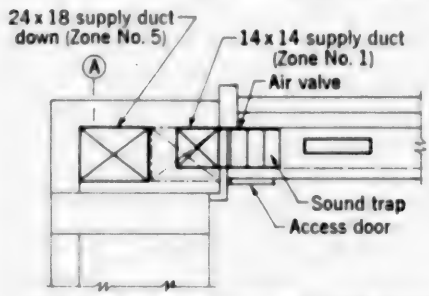
The single-duct, all-air distribution system is simplicity itself. A minimum of vertical risers within the columns carries high velocity air, at no penalty to rentable space, to horizontal plenums that consist, in part, of the wall and floor. High static regain assures a stable system. Tenants have the advantage of a zoned central system plus a suitable degree of individual control.



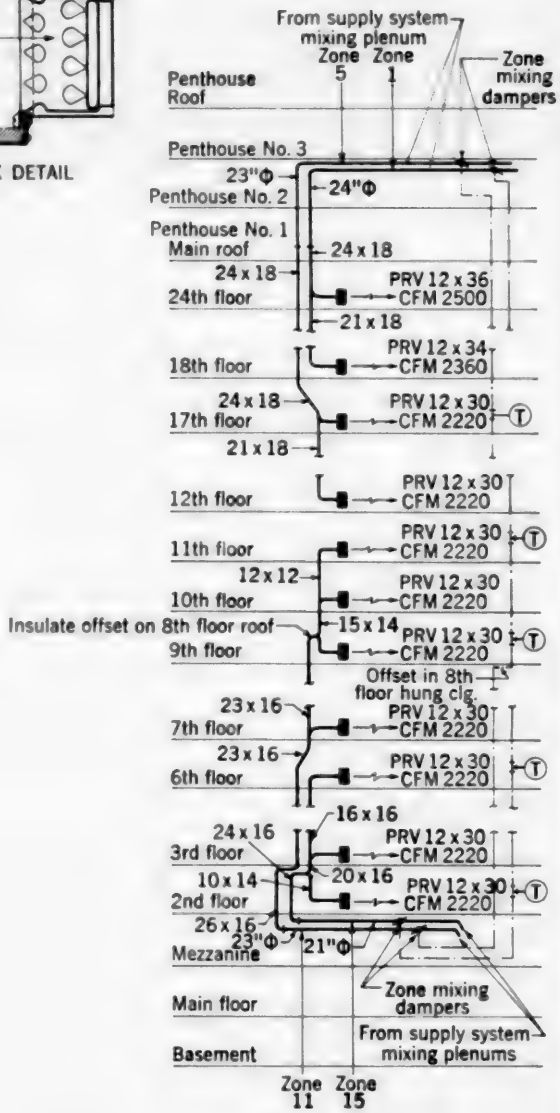
SOUND ATTENUATION BOX DETAIL



TYPICAL PLAN OF PERIPHERAL AIR DISTRIBUTION



PART PLAN OF ENCLOSURE AT 18TH FLOOR



RISER DIAGRAM FOR NORTH EXTERIOR ZONES

Representative Selections from Drawings for the Heating and Air Conditioning System, of a Large Commercial Office Building employing up-feed and down-feed, all-air, high velocity ducts in the columns, and special horizontal distribution of which the wall and floor form two sides.

Computer Room Air Conditioning: An Improved Method

GEORGE C. LEWIS, P.E.

George C. Lewis & Associates, Philadelphia, Pa.

AN IMPROVED METHOD of air conditioning for computer rooms has been developed through cooperation between the engineers at General Electric Co., Missile and Space Vehicle Dept., Philadelphia, and the author's consulting engineering firm.

The improvement is in the method of supplying cooling air to the computers and of returning the air to the conditioner, which permits separate control of conditions in the computers and the room.

In previously installed computer rooms, air for cooling the computers was taken individually by each computer from the room itself and returned to the room warmed up by the internal heat in the computers.

This warmed the room and it was necessary to deliver excessive quantities of cool air through the room ceiling diffusers to hold down the room temperature. Severe cold drafts were the inevitable result.

Since this installation, like most large computer rooms, required a raised floor to accommodate the computer interconnection cables, it was decided to take advantage of this feature for air conditioning. Accordingly, the elevation of the floor was set at 15¼ inches instead of the more usual 8 to 10 inches, providing clearance beneath the floor for 12-inch supply air ducts. As shown in diagram, these connect through the floor to the bottom panel of each computer enclosure. The air is forced into the computer by the static pressure of the central unit, permitting removal of internal fans in the computer. This aids in cutting down stray electrical "noise" in the computers. The cool air rises through the interior of each computer, warming up on its way, and is discharged vertically at moderate velocity through the top panel of the computer.

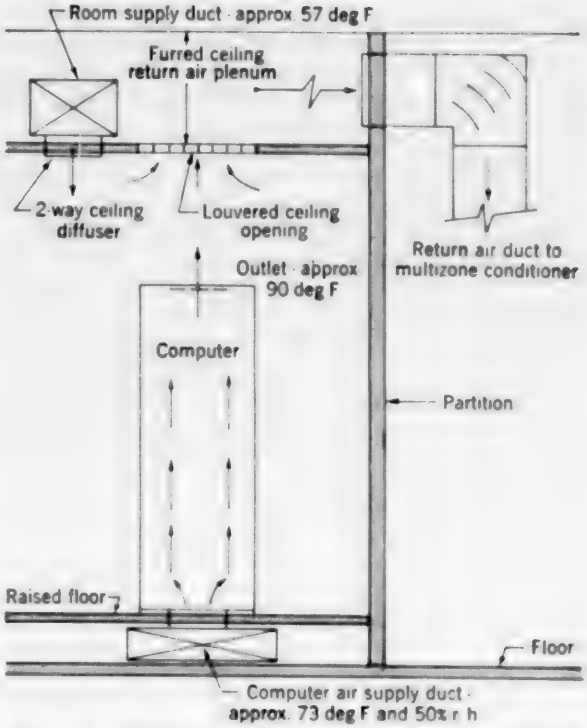
A return air plenum was constructed by installing a false ceiling in the room approximately 18 inches above the computer tops, and a continuous return air slot was constructed in the false ceiling directly above the computers. A lightweight egg crate grille was placed in the return air slot for appearance.

The warm air discharge from the computers enters the return air plenum through the slot without diffusing into the room. The return slot also returns room air, and the result is that the computer heat affects the room only slightly, so that the room cooling load drops off very sharply.

This results in a sharp reduction in the need of cool air for the room itself, and reduces the previous drafts which were caused by excessive cold air volume through the occupied area.

In addition, care was taken, by using two-way type ceiling diffusers, to avoid mixing of supply and return air streams.

A zone-type air conditioner with a chilled water cooling coil and a steam heating coil mixes cool and warm air to suit the computers separately from the room supply, permitting air delivery to the computers at 73 to 76 deg F while maintaining the desired room condition between 70 and 80 deg, both with approximately 45 to 55% relative humidity.


Room supply duct · approx. 57 deg F
Furred ceiling return air plenum
2-way ceiling diffuser
Louvered ceiling opening
Outlet · approx 90 deg F
Return air duct to multizone conditioner
Computer
Partition
Raised floor
Floor
Computer air supply duct · approx. 73 deg F and 50% r h

Section of computer room shows construction alterations required to accommodate the air conditioning system.

Return air is used for reheat, the steam coil being required only when the plant is starting up from a cold condition. Fresh air is limited to bare requirements, so that it does not affect humidity too much.

A limited humidity control is obtained under command of a room humidistat by varying the temperature of the chilled water supplied by a packaged chiller. A steam evaporator type humidifier is also provided.

Year-round operation is arranged for, including a dry-type refrigerant condenser equipped with cold weather hot gas pressure control.

The improvements include:

1. The cooling air supply to the computers is independent of room temperature and is separately controlled;

2. A single air conditioner maintains the desired conditions for both computers and room; and

3. Drafts in the room have been reduced to a minimum, resulting in comfortable working conditions.

This 40-ton packaged air conditioner carries the load in the main banking area, discharging through grilles shown in cover photo. Fresh air is drawn through duct to adjacent window in the rear of the bank. Engineer Robert J. Hill of S. J. O'Brien Companies points to reversing switch that equalizes wear on the four compressors. Throwing switch reverses order of compressor use. Photos from Typhoon Air Conditioning Div., Hupp Corp., Brooklyn, N. Y.

Seven Packaged Units Net Bank Better Cooling at Less Cost

Typical of the problems being solved through the flexibility of packaged air conditioning equipment were those posed by the several special activity areas and the design of the ceiling over the main banking area in the three-story, forty year old main office of Bronx River Savings Bank, New York City.

A glance at this month's cover photo reveals the intricacy of the ceiling's neo-classic design, fitting the building's modified Greek temple architecture, popular in financial buildings. Circular diffusers in that ceiling, no matter how discreetly placed, were out of the question. This obviated the usual treatment, that of using a single, built-up central cooling plant, mounted on top, with holes cut in the ceiling for supply and return air.

Installation of seven Typhoon packaged air conditioners, in a system designed and installed by S. J. O'Brien Companies, New York, solved not only the problem of preserving the fine old decor, but satisfied also the several special requirements that called for extreme flexibility, a flexibility difficult to attain with a central system.

How Three Units Handle Main Area

Three packages, totaling 60 tons capacity, handle the cooling load in the main banking area.

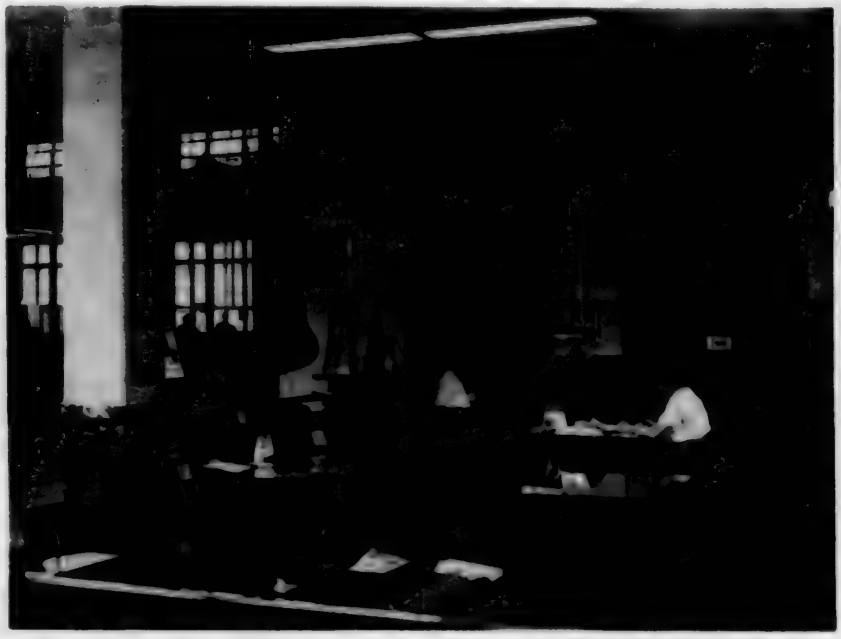
Unit 1. Through four large, square openings, cut in the travertine marble wall flanking the master clock high up on the rear wall of the area, a 40-ton package discharges (and exhausts) 12,000 cfm high over the main banking area, creating a draftless atmosphere for both main floor area and office spaces ranged on the narrow balcony along three sides of the room. In addition, small quantities of air are bled off this main unit to condition the work room on the second floor in which the unit is located, and the ladies' lounge on the floor below. The work room is not completely occupied by the large packaged unit. State auditors use it four times a year and employee training sessions are held there.

Unit 2. Placed in a rear work room on the first floor, a 15-ton package handles the areas shielded by the overhanging balcony, feeding through small grilles in the marble walls.

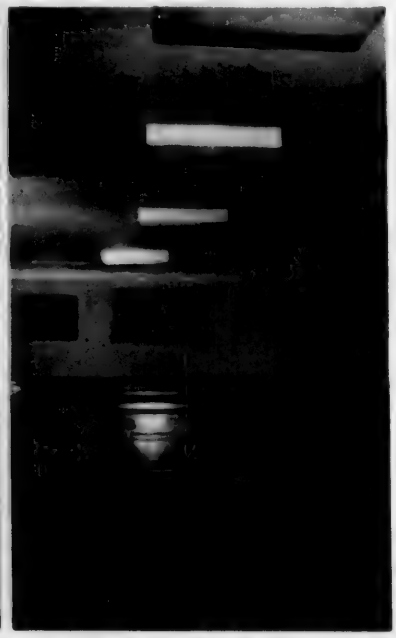
Unit 3. The New Accounts area, along the front wall of the main banking area, is served by a free-standing, 5-ton unit. (See photo on next page.)

Four Problems and Four More Units

Unit 4. In the Mortgage Department on the second floor, a 16 by 30 ft skylight admits so much sunlight that cooling might be required even in winter for the seventeen employees there. To make air conditioning available when other areas do not require it, a separate 15-ton package is installed against one wall of the



A free-standing 5-ton unit provides cooling for the New Accounts area in an alcove at the front of the main banking area.



Coupon clipping booths are cooled by unit in basement lobby.

room. A fresh air duct, equipped with automatic damper, runs to the roof. In winter, outside air will handle the entire cooling load. Cool air is distributed by a length of duct next to the high ceiling. Four grilles in the duct supply a total of 4750 cfm to the mortgage room and another 1200 cfm to the officers' platform and public reception area adjoining.

Basement Unit Cooled with City Water

Unit 5. When the original proposals to use a central system were made, the basement vault and coupon clipping room had to be ignored because of the high cost of running ducts all the way down from the roof. Isolation of the area raised the possibility that cooling would be needed there intermittently throughout the year. The area is now served by a special package, with two 3-ton compressors and an extra-large cooling coil. This special unit is the largest permissible, under New York City water conservation regulations, where city water is dumped, rather than being recirculated through cooling towers.

Two Air-Cooled Units

Unit 6. The employees dining room requires cooling year-round, but only for the relatively short luncheon period, because of heavy occupancy and the adjacent kitchen. A 5-ton package with roof-mounted, air-cooled condenser serves the space handily.

Unit 7. The board room also requires special treatment. It is used primarily at night, when operation of the cooling towers for a single room's comfort seemed unwarranted. Another 5-ton air-cooled package suffices for this application.

What Was Gained by this Arrangement?

Altogether, 92 tons of air conditioning are split among seven packages. Briefly, this is what resulted:

(1) In the main banking area, an unobtrusive, flexible system provides draftless cooling while leaving the fine, old architecture intact.

(2) A finer degree of control than could have been achieved, except, perhaps with the most elaborate central system, is achieved. Because the 40-ton unit is equipped with four 10-ton compressors, and the 15-ton unit on the first floor with two 7.5-ton compressors, a very smooth response to ambient changes is possible, with six capacity steps between full-off and full-on.

(3) Frequent on-off cycling is eliminated, a most happy circumstance where, as in a bank, there are many women, sensitive to temperature changes.

(4) Division of the load seven ways precludes the embarrassment and discomfort that failure of a single central system can cause. The bank, at one of its three branches, had that happen to it on a previous summer.

(5) Considering the variety of cooling problems in the bank, the cost of installation, slightly above $600 per ton, was low. The total cost of 92 tons fell short of the proposals originally made for a central system, yet provided cooling in the basement that was not encompassed in the original scheme.

(6) Operating costs, management reports, have been equally low because the entire system does not have to be turned on when cooling is required in only one or two areas.

Decentralized Heating Chosen for Garden Apartments

A decentralized hydronic system for 62 garden apartments has realized a 15 to 20% saving over a central system, according to the builder-owners of

Dalewood Gardens in Hartsdale, N.Y. Main item in this heating system is the compact G-2 gas-fired boiler, by American-Standard, which has been installed in small closets, attics or basement utility rooms, depending on the location of the apartment heated.

Covering some 35 acres in Westchester County, Dalewood Gardens comprises five sections of garden apartments. Of these five, four were constructed with central heating, and the last and newest section of 62 units features decentralized heating. Main-floor apartments are heated by 33½-inch high boilers installed in small closets under stairs, shown in photo at right. The installation is inconspicuous, yet is easily accessible for maintenance. In the upstairs apartments, boilers are installed in the attic. Ground-floor (maisonnette) apartments are serviced by heating units in basement utility rooms.

Builder-owners of Dalewood Gardens, and the plumbing and heating contractor, are sold on this type of heating for garden apartment construction. Weir & Sons, of Hartsdale, who had the package plumbing and heating contract, used substantially smaller tubing than would be possible with a large central system. Important, too, was the elimination of long pipe lines

required in garden apartment construction. Heating system also provided savings with the elimination of boiler room and chimney (metal-jacketed asbestos vent pipe was used with each boiler).

Air Conditioning Aids Child Behavior Studies

A controlled atmosphere in the new $1 million Program Building at the Merrill-Palmer Institute, Detroit, Mich., will eliminate one of the variables in child behavior studies, according to David J. Williams, development director of the Institute.

"No longer will we have to allow for changing attitudes and moods due to the weather," Mr. Williams said. "This should contribute significantly to the quality of many of our long-term studies."

When completed this spring, the completely air conditioned building will house class rooms, faculty and administrative offices, nursery school facilities, observation booths, a library, play therapy rooms, dining room, and other specialized facilities. It also has a centrally-located play area.

An average of 100 carefully-selected students spend part of their junior or senior college years, or a full graduate year, at Merrill-Palmer studying all phases of human behavior. In addition, educational opportunity in the fields of human development and family and community life are provided for a variety of professional and lay groups.

Last year over 3700 individuals participated in the Merrill-Palmer educational program. An important part of this program is the observation of infant and child behavior, which is sometimes affected by discomfort caused by variations of temperature and humidity in the activities areas and observation booths. "With air conditioning, these variables will be removed and we will be better able to observe behavior under consistent conditions," Mr. Williams said.

Source of chilled water for air conditioning is a Carrier absorption refrigeration machine which operates on district steam supplied by Detroit Edison Co.

The new building, designed by O'Dell, Hewlett and Luckenback Associates, local architect-engineers, is the first specifically made to meet the 40-year-old school's needs. Darin & Armstrong, also of Detroit, is the general contractor.

Louis Blendermann on PLUMBING and PIPING

Interior Sand and Sediment Traps

THE previous article discussed the various types of exterior sand traps and their applications. In this article information is presented on some of the different types of structures and devices that are used in a building to intercept and retain sand, sediment and other forms of debris.

Application

Structures and devices that will intercept sand, sediment and debris are required for many applications in buildings and some of the areas where they may be used are: Basement areas, storage areas, equipment rooms, kitchen areas, foundation drainage systems, garages, industrial areas, manufacturing areas, processing areas, car wash areas, planting areas, and roof drainage systems.

It is extremely important in a building to prevent underground drainage lines from becoming blocked or partially blocked because of sediment accumulations for collected matter will harden in time to cause serious conditions. This situation can occur in sanitary, waste or storm drainage lines. The important thing regarding drainage lines is to intercept and retain this debris and sediment matter.

Running Traps and P-Traps

Running traps and P-traps serve to some extent in intercepting and retaining matter, as shown in Fig. 1. Much of the sediment that enters a fixture will be intercepted and retained by the P-trap. This matter is easily removed by means of the cleanout plug that is a part of the trap. However, the P-trap has certain limitations and when these are exceeded, other methods must be employed to intercept and retain the matter.

A running trap with double cleanouts is placed in the sanitary drainage line in the building. While its basic function is not the interception and retention of matter, it is surprising just how much matter will settle in the trap for lack of proper provision elsewhere.

A running trap for a leader line will intercept a considerable amount of sediment since a good deal of matter generally settles on a roof and finds entry to the interior storm water piping. The prime purpose of the trap at the base of the leader line shown in Fig. 1, is to intercept large foreign objects that gain entry through the roof drains.

These traps have a specific function more important than the interception of sand and sediment that enters the respective systems. Special structures and devices should be considered when heavy concentrations of matter must be handled.

Fixture Traps

Figure 2 shows the type of unit that may be placed under a sink or lavatory when heavy concentrations of matter are discharged into the fixture.

The sediment trap in this case consists of a circular drum, equipped with an inlet and outlet of the two types shown. Inside the drum is a perforated basket that may be removed through the cleanout plug at the bottom of the unit.

Waste water from the fixture will pass into the unit where the clear water will pass through the perforated basket while substances heavier than water matter will settle to the bottom of the basket where it can be removed at frequent intervals.

This unit also serves as a fixture trap because it has a water trap seal. There are many varied applica-

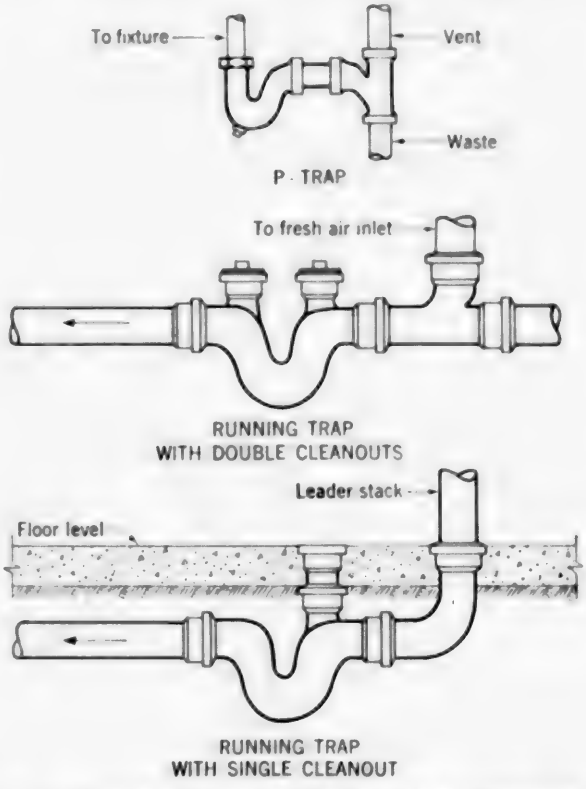


Fig. 1. Types of traps that may be used to intercept and retain sand and sediment.

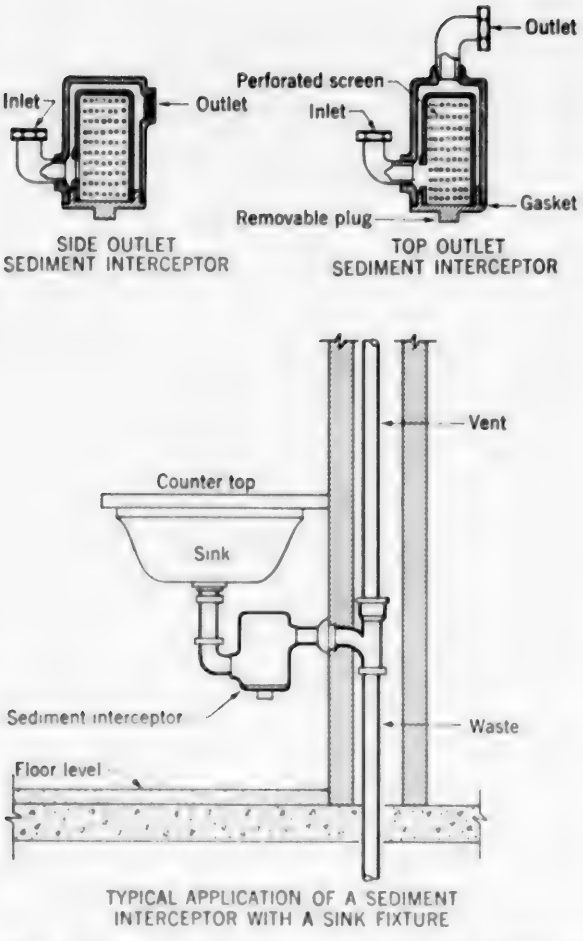


Fig. 2. Styles of units that can be used with fixtures to intercept and retain sediment.

tions for this type trap; it must be installed with sufficient clearance below the unit to permit the perforated basket to be removed. When sediment of fine texture is to be intercepted, a mesh screen may be used with the basket. The sediment trap shown is only for example for there are other types that can be used with equal success.

Floor Drains

Floor drains that include the means for intercepting and retaining sand, sediment and debris may be obtained for specific functions or applications, and three such drains are shown in Fig. 3.

The small bottom outlet floor drain illustrated is a general purpose type. It serves a very useful purpose in basements, storage areas and for other general purpose applications where some matter is washed into the drain and must be intercepted and retained. The bucket is a slotted type and intercepted matter will be retained at the bottom of the bucket. A feature of this drain is that the grate cannot be replaced unless the bucket is in place. This type drain is available in different sized tops and can be obtained with side outlets.

The floor drain of the deep sump type is ideal for equipment rooms or spaces, as well as other heavy duty areas where the incident of sediment is rather high. The grate is a heavy duty type that will withstand heavy traffic loads such as lift or fork trucks. The bucket is rather deep to hold a large accumulation of matter. The top portion of the bucket is perforated to retain as much as possible of the intercepted matter, including floating debris. This type drain is also available with different sized tops and may be had with a side outlet instead of the bottom outlet shown.

The floor drain with deep sump and side outlet is representative of the large capacity floor drains that are available for extremely heavy sediment concentrations. These drains are ideal for industrial, manufacturing and processing area applications. The grate is a heavy duty type to withstand the weight of heavy traffic loads. The bucket, of large capacity, can retain considerable amounts of matter. Fine mesh screens are used on all four sides of the bucket to retain as much as possible of the matter.

In addition to the drains illustrated, other styles are available. Traps are usually required with the drains shown and are generally of the running trap type. They provide the water trap seal required to prevent sewer gases from the underground drainage lines, discharging at the drain. P-traps can also be used with the bottom outlet drains. Many codes require that floor drains be vented. When venting is needed, it should conform with the local code. When the floor slabs are to be watertight, clamping collars can be furnished with the drains to secure the watertight flashing to the drain and thus offer a watertight installation. Al-

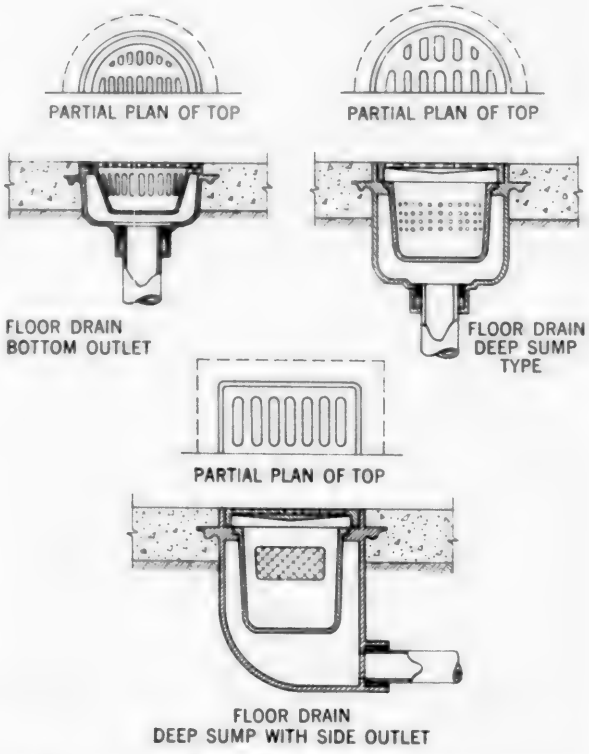


Fig. 3. Types of drains that are available for the interception of sand and sediment.

though caulked outlets are shown, threaded outlets are also available.

Concrete Structures

On occasion, one may desire to build a combination drain and sand-sediment trap of the type shown in Fig. 4. The concrete pit then would be constructed as shown and lined with waterproofing material to maintain tightness and a grate would be fitted on top of the structure. If heavy traffic loads will exist, reinforced concrete is used and a heavy duty grate and frame installed.

The outlet is fitted with a hood to assure a proper trap seal and to prevent floating debris from entering the outlet. The outlet piping passes through a watertight sleeve to ensure a leakproof connection. The depth of the pit below the outlet connection must be determined to fulfill retention requirements for the particular application. The local code should always be consulted regarding the use of this type of drain.

This drain has considerable merit for use in areas where large quantities of sand or sediment are washed into the drain—such applications as greenhouses, garages or storage areas.

Large capacity cast iron drains similar in function to a concrete pit may also be utilized with this application. There are a number of styles and sizes from which to choose.

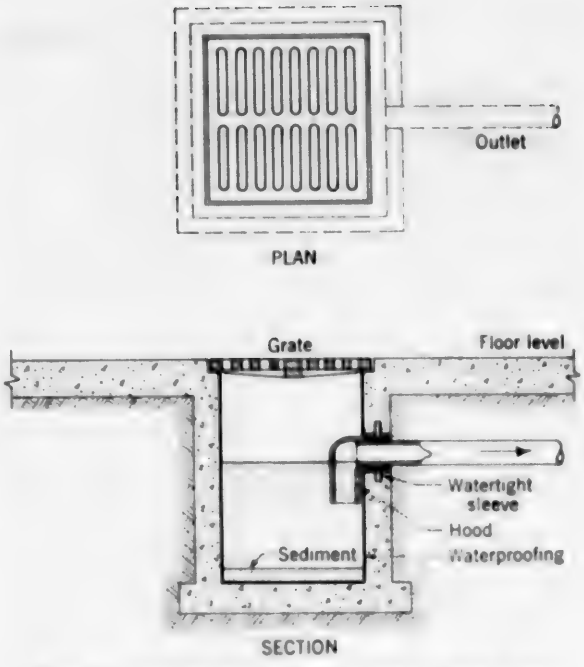


Fig. 4. Combination drain and sand sediment trap.

In-Line Sand and Sediment Traps

Frequently, when a series of drains are involved, each handling a constant discharge of water, it is advisable to consider the use of in-line sand and sediment traps of the type shown in Fig. 5. Note that the trap is placed between the series of floor drains and the main sanitary drain line into which the floor drain branch line will discharge. The sand and sediment trap in this case is a cast iron basin and is equipped with a cover that is easily removed.

Although vents have not been shown for the drains, the venting must be handled in a manner prescribed by the local code requirements. The drains do not include traps, therefore a hood should be placed on the outlet connection to offer the necessary watertrap seal.

When drains are installed in a garage, aircraft hangar, or other areas where there is the danger that volatile liquids will be discharged into the drains, thus creating a potential hazard, then approved types of oil separating equipment must be installed in a manner prescribed by the local plumbing and fire codes. Such systems will not be covered in this article.

Concrete and Cast Iron In-Line Units

In-line sand and sediment traps may be of cast iron or concrete as detailed in Fig. 6. The cast iron unit comes in varying sizes and depths to satisfy any requirement. The outlet connection is equipped with a tee as shown, or a regular hooded outlet. This provision must conform to local code standards. The out-

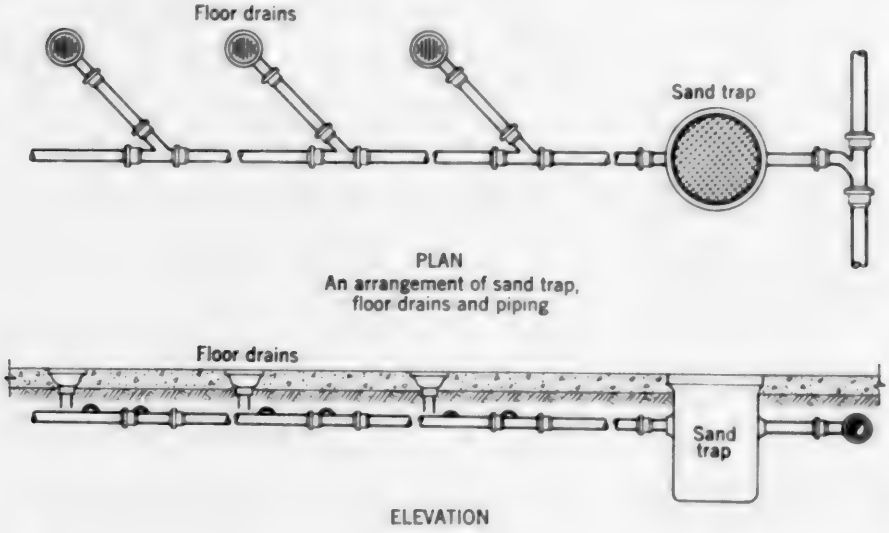


Fig. 5. How a cast iron basin can be used as a sand trap to intercept sediment washed into floor drains.

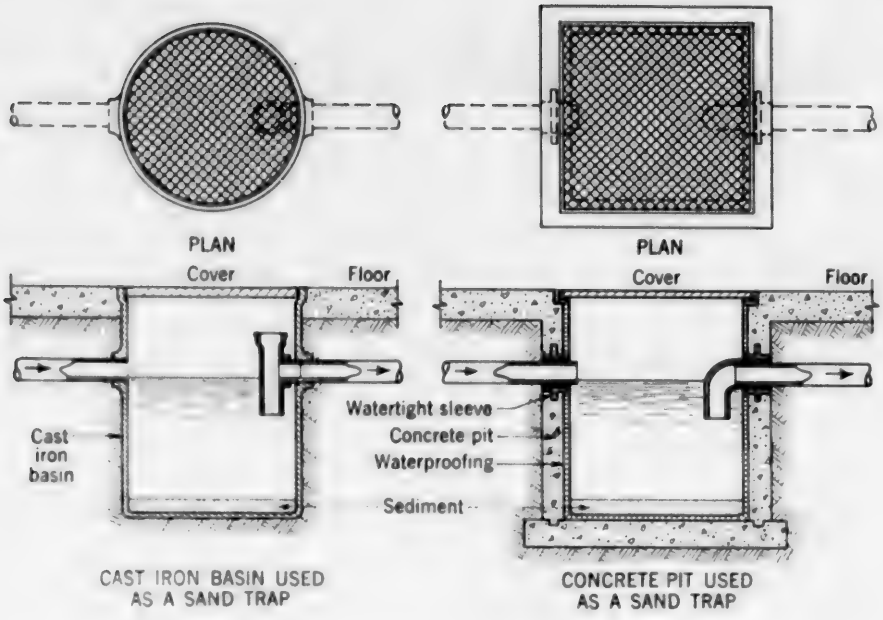


Fig. 6. Two types of structures that can be used for sand traps.

side of the cast iron basin is generally painted with a protective compound for longer life.

The concrete pit can be constructed of a size or depth to meet construction needs. The outlet connection is equipped with a hood or with a tee if allowed by local code. When hoods are used with sand or sediment traps, it is generally required that they will provide a trap seal of at least 4 to 6 inches, depending upon local code demands.

The in-line sand and sediment trap is recommended for all areas or applications where large quantities of water with heavy concentrations of sediment and debris are handled.

Combination Trap and Sump Pit

The sand and sediment trap shown in Fig. 7, has just one purpose and that is to intercept matter before it can reach a sump pit where it can damage the pumping apparatus.

The combination trap and sump pit is used for a series of floor drains installed at the lower floor levels in a building where such drains are at a lower elevation than the building drain. Thus the sand and sediment traps intercept and retain matter that is discharged into the drains, while the clear water waste passes on into the sump pit where it is pumped up to the elevation of the building drain to discharge by gravity to the street sewer facilities.

The combination trap and sump pit is also used with subsurface and foundation drainage systems. The waste water in this case is conducted to the trap pit where the foreign matter settles at the bottom of the pit while the clear water passes into the sump pit.

The arrangement is also practical for exterior drainage systems. Here the underground piping is run into the building and connects with the trap pit. Foreign matter washed into the drains is intercepted and retained by the trap while the clear water waste is pumped up to the elevation of the storm water sewer and thus runs by gravity out to the street storm sewer facilities.

The trap and sump pits are constructed of concrete, or of reinforced concrete when extra strength is required. The pit interior is lined with waterproof material. Steel covers are placed at the top as shown. The size and proportions of this arrangement must be designed properly to handle the needs of the specific application. Moreover, the local plumbing code should always be consulted for recommendations.

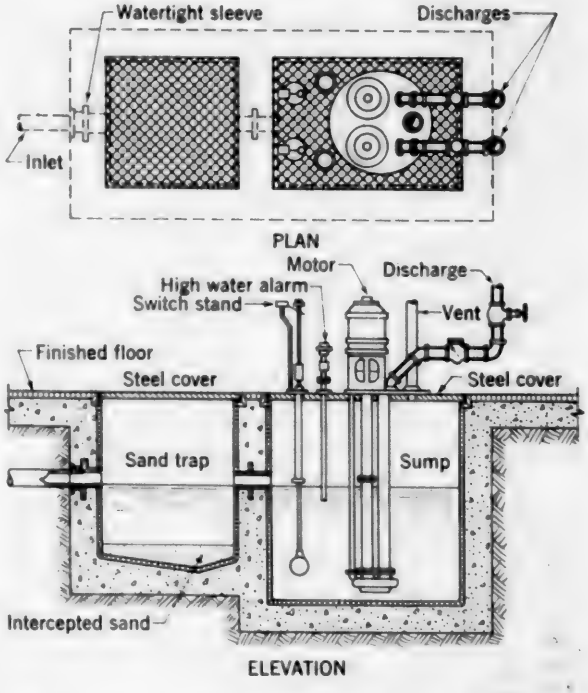
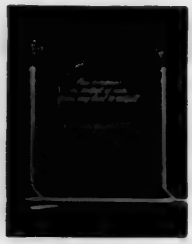


Fig. 7. How a sand trap is used with a sump pit.

NEW LITERATURE

Use the prepaid postcard on last page for securing your copies of these catalogs.



Storm Water Drainage Systems

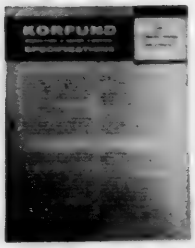
In this 10-page bulletin, Johns-Manville, New York, N. Y., tells why Transite pipe means new economies in storm water drainage systems. Bulletin includes detailed layouts of drain systems, as well as design data and guide specifications for materials and installation.

Circle **Item 1** on Inquiry Card

Water Hammer Arrestor

Six-page Manual 60-2, published by Zurn Industries, Inc., Erie, Pa., describes the company's all-stainless-steel water hammer arrestor, called Shoktrol. Also described is new sizing method which permits scientific selection of arrestors for multiple branch installations.

Circle **Item 2** on Inquiry Card



Vibration and Noise Control

A 6-page guide to writing vibration and noise control specifications for air conditioning and related equipment is available from The Korfund Co., Inc., Long Island City, N. Y. It recommends and illustrates vibration control mountings for specific types of equipment.

Circle **Item 3** on Inquiry Card

Hydronic Products

Bell & Gossett Co., Morton Grove, Ill., announces 28-page Catalog GC-1259A illustrating and describing its line of hydronic products for primarily residential use. These Hydro-Flo products include pumps, valves, compression tanks, water heating units, and others.

Circle **Item 4** on Inquiry Card

Evaporative Condensers

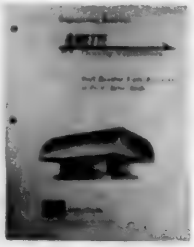
24-page Bulletin 107 covers the complete line of evaporative condensers available from Baltimore Aircoil Co., Inc., Baltimore, Md., in single, factory assembled units from 10 to 700 tons. Includes diagrams, capacity and performance data, and selection tables.

Circle **Item 5** on Inquiry Card

All Purpose Centrifugal Fans

A 76-page catalog, No. 1120-1, from Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Mass., describes Series 3000 all purpose centrifugal fans with flat, backwardly inclined blading. Fans are suitable for supply and exhaust, industrial air conditioning, etc.

Circle **Item 6** on Inquiry Card



Gravity Ventilators

Engineering data for quick selection of Airette square and rectangular gravity ventilators are presented by Penn Ventilator Co., Inc., Philadelphia, Pa., in 6-page Bulletin AEG-60. Ventilators may be used as discharge or relief outlet units, or as fresh air intake hoods.

Circle **Item 7** on Inquiry Card

Steel Welding Fittings

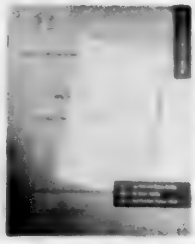
The Husky line of steel welding fittings for Schedule 40 piping is described in Catalog H-2 by Nibco, Inc., Elkhart, Ind. A new addition to the company's product line, eccentric reducers, and recent Husky installations are featured. Included are technical data and tables.

Circle **Item 8** on Inquiry Card

Air Conditioning Equipment

Air conditioning equipment for industrial and commercial use is available from Airtemp Div., Chrysler Corp., Dayton, Ohio, in a wide range of models and sizes. An 8-page descriptive bulletin includes packaged liquid chillers, packaged central station units, fan-coil units, etc.

Circle **Item 9** on Inquiry Card



Coal-Fired Package Boiler

Guide specifications for application of the Coal-Pak Automatic package boiler to low-pressure steam heating, hot water heating and high-pressure process steam are contained in a 36-page brochure, GS-3, published by Bituminous Coal Institute, National Coal Assn., Washington, D. C.

Circle **Item 10** on Inquiry Card

Safety Relief Valves

A 28-page catalog, published by Farris Engineering Corp., Palisades Park, N. J., describes liquid relief and special-service safety relief valves. Valve selection is simplified in Catalog FE-138 by utilizing its sizing data, capacity tables, and generous application data.

Circle **Item 11** on Inquiry Card

Adjustable Speed Fluid Drives

A 20-page bulletin describing the company's Class 4 line of adjustable speed Gyrol fluid drives is available from American-Standard Industrial Div., Detroit, Mich. Bulletin A-719 discusses principles of operation, shows typical applications, and includes selection guides.

Circle **Item 12** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of these catalogs.

Industrial Exhausters and Blowers

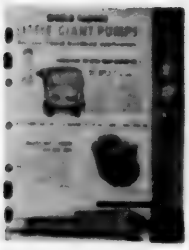
The engineering handbook section of Bulletin IF-100, from General Blower Co., Morton Grove, Ill., includes air volume tables, corrosion data, drying temperatures, velocity requirements, and other information pertinent to a mechanically sound exhaust or blower system.

Circle **Item 13** on Inquiry Card

Scotch-Type Boilers

A 6-page bulletin covering new, packaged Scotch-type 3-pass boilers is available from Burnham Corp., Irvington, N. Y. Engineered for efficiency and low maintenance service with gas, oil, or oil-gas burners, boilers are described with diagrams, ratings and dimensions.

Circle **Item 14** on Inquiry Card



Pumps

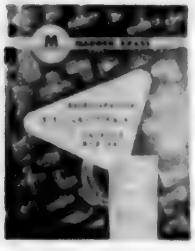
Pumps for any liquid handling application are offered by Little Giant Pump Co., Oklahoma City, Okla. A 4-page bulletin describes these pumps; data cover submersible circulator units, heavy duty pumps, condensate tank units, vaporizer assembly, and a portable, screened model.

Circle **Item 15** on Inquiry Card

Blast Coil Space Heaters

Electric blast coil space heaters for duct installation are the subject of 32-page Catalog E-97U, published by Industrial Engineering & Equipment Co., St. Louis, Mo. The catalog includes descriptions of the heaters and application information, plus complete heater ratings.

Circle **Item 16** on Inquiry Card



Products for Air Conditioning

A 28-page catalog, No. R-460, from Madden Brass Products Co., Aurora, Ill., illustrates and describes products for air conditioning and refrigeration. These include flare tube fittings, hermetic port valves, color-coded charging lines, driers, strainers, and many others.

Circle **Item 17** on Inquiry Card

Indoor Cooling Towers

Suitable for installation indoors and out, AquaCooler cooling towers are described in Bulletin No. AC-60 by The Marley Co., Kansas City, Mo. The 6-page bulletin includes performance data, specifications, and diagrams which show water flow and air flow options.

Circle **Item 18** on Inquiry Card

Motor Application Guide

Century Electric Co., St. Louis, Mo., announces its 1960 motor application guide. This 16-page catalog features selection charts which relate motor type and characteristics to the requirements of specific applications. Company's latest motor designs are described.

Circle **Item 19** on Inquiry Card

Welded Steel Pipe

Uses of welded steel pipe, ranging from heating, plumbing and sprinkler systems to snow melting and ice rinks, are illustrated in an 18-page bulletin from The National Supply Co., Pittsburgh, Pa. Spang CW Steel Pipe Bulletin No. 509 includes 6 pages of specification tables.

Circle **Item 20** on Inquiry Card

Sound Control Curb

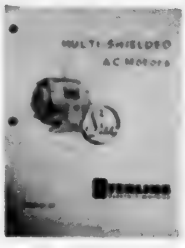
Full details and specifications on its QT sound control curb for power exhausters are set forth in Bulletin 60 SC by Jenn-Air Products Co., Inc., Indianapolis, Ind. The 4-page bulletin includes performance graphs, mounting drawings and dimensions for eight models.

Circle **Item 21** on Inquiry Card

Air Cooled Condensers

Recold Corp., Los Angeles, Calif., announces 8-page Catalog No. 34C9a describing its Dricon line of air cooled condensers. Catalog contains performance data, and information for unit and multi-circuit selection. Use of condensers as jacket water coolers is also described.

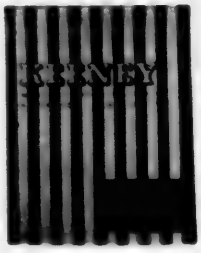
Circle **Item 22** on Inquiry Card



A-C Motors

Multi-Shielded motors, in sizes from ¼ to 200 hp, are described by manufacturer, Sterling Electric Motors, Inc., Los Angeles, Calif., in 56-page Catalog No. 200. It includes a special section dealing with selection and application making catalog especially useful in specifying a-c motors.

Circle **Item 23** on Inquiry Card



Plumbing and Heating Specialties

The Keeney Manufacturing Co., Newington, Conn., announces a new, 40-page catalog covering its broad line of plumbing products and heating specialties. Included are tubular brass plumbing goods, floor and ceiling plates, electric humidifiers, automatic and manual air valves, etc.

Circle **Item 24** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of these catalogs.

Belt-Driven Tubeaxial Fans

Propellair Div., Robbins & Myers, Inc., Springfield, Ohio, announces 8-page Bulletin No. 625 describing 30 to 60-inch dia belt-driven tubeaxial fans. Bulletin also includes data on ventilating systems with emphasis on hood design and open surface tank ventilation.

Circle **Item 25** on Inquiry Card

Scale Model Components

Twenty vessels, 8 heat exchangers, and 11 pumps of three different types are available in molded expandable polystyrene from Industrial Model Supplies, Inc., Wilmington, Del. These and other scale model components are described in an 8-page catalog which is offered.

Circle **Item 26** on Inquiry Card

Ventilating Equipment

Catalog No. 592 describes the line of quality ventilating equipment available from Broan Mfg. Co., Inc., Hartford, Wis. Included in 12 pages are range hoods, twin blowers, ceiling and wall fans, ventilating fan units and light units, as well as electric wall heaters.

Circle **Item 27** on Inquiry Card

Pipe Unions and Check Valves

A 20-page catalog, No. 60, from Catawissa Valve & Fittings Co., Catawissa, Pa., contains complete information on Perfect Seal pipe unions and swing check valves. Emphasized is new convertability feature whereby standard weight pipe unions can be converted to orifice type.

Circle **Item 28** on Inquiry Card

Welding Machines

Miller Electric Mfg. Co., Appleton, Wis., offers a 12-page booklet describing "a full line of fine welders." Some 40 different models are covered, including d-c, a-c and a-c/d-c welders, gasoline and diesel driven units, and accessories and controls for all of the company's models.

Circle **Item 29** on Inquiry Card

Thermal Insulating Materials

"Re-thinking Thermal Insulation," a 16-page booklet published by National Insulation Manufacturers Assn., New York, N. Y., is a guide to the best use of thermal insulating materials. It emphasizes the "economic thickness" approach to specification, and includes a worksheet.

Circle **Item 30** on Inquiry Card

Circulating Pumps

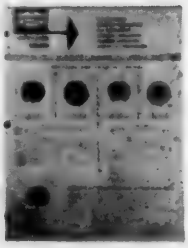
Selection and design data for vertical design, space saving, hot and cold water circulating pumps are included in Bulletin No. VKY-6900B, published by Weil Pump Co., Chicago, Ill. Bulletin includes photos which show typical applications of these mechanical-seal equipped pumps.

Circle **Item 31** on Inquiry Card

Low-Voltage Distribution Equipment

An 84-page catalog, GEC-1100B, is designed for easy selection, application, pricing and ordering of low-voltage distribution equipment made by General Electric Co., Plainville, Conn. Products include circuit breakers, motor control centers, and distribution panelboards.

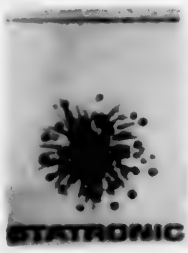
Circle **Item 32** on Inquiry Card



Pressure and Vacuum Gages

A 4-page specification bulletin for pressure and vacuum gages, industrial and dial thermometers for piping and duct installations, and recording instruments for temperature, pressure and humidity is offered by Weksler Instruments Corp., Freeport, L. I., N. Y.

Circle **Item 33** on Inquiry Card



Dirt and Dust Control

CRS Industries, Inc., Philadelphia, Pa., offers a folder describing the Statronic System, a new method of dirt and dust control which operates by statically bombarding dirt and dust particles, negatively-ionizing and shattering them to a size well below 0.1 micron.

Circle **Item 34** on Inquiry Card

Plastic Sewer Mains

A 4-page bulletin describing the advantages of its plastic sewer mains is published by Evanite Plastic Co., Carrollton, Ohio. Bulletin elaborates on these advantages: rapid jointing, elimination of leakage, best flow characteristics, and long service life of sewer systems fabricated from plastic.

Circle **Item 35** on Inquiry Card

Pressure Regulators

Information on its complete line of Sliding Gate pressure regulators is given in Catalog J160-1 by OPW-Jordan Corp., Cincinnati, Ohio. The 8-page catalog describes four types of regulators and gives applications for each. Sizing charts and sample specification are included.

Circle **Item 36** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of these catalogs.

Molded Pipe Insulation

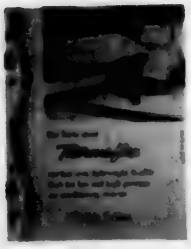
Thermal, mechanical and chemical properties of Gem-Foam, a low-temperature pipe insulation molded of polyurethane foam, are contained in bulletin offered by Baldwin-Ehret-Hill, Inc., Trenton, N. J. Also described is Gemfil, a foam-in-place insulation for fittings, valves, etc.

Circle **Item 37** on Inquiry Card

Underground Sprinklers

Keeping American lawns beautiful is the theme of a 24-page catalog offered by Rain Jet Corp., Burbank, Calif. Catalog includes complete operating data, specifications and recommendations for use for sixteen models of underground sprinkler heads.

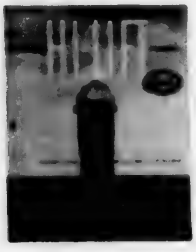
Circle **Item 38** on Inquiry Card



Flexible Ducting

A 4-page bulletin describing uses and advantages of flexible ducting in the air conditioning industry is offered by Flexible Tubing Corporation, Guilford, Conn. Reported features include up to 30% savings in installation costs as well as improved air flow characteristics.

Circle **Item 39** on Inquiry Card



Positive Displacement Pumps

A 10-page bulletin, No. B-142, describing advantages of positive displacement pumping action of its Hi-Lift pumps, is available from Peerless Pump, Hydrodynamics Div., FMC Corp., Los Angeles, Calif. Bulletin also contains many helpful pointers on evaluating water needs.

Circle **Item 40** on Inquiry Card

Line of Gaskets

The Palmetto line of gasketing and gaskets for flanges, joints, boiler manholes, etc., is illustrated and described in sectionalized 12-page catalog offered by Greene, Tweed & Co., North Wales, Pa. Data include composition, temperature limits and recommended service.

Circle **Item 41** on Inquiry Card

Insulation Adhesives

Adhesives and coatings for commercial and industrial insulation applications are manufactured by Insul-Coustic Corp., Maspeth, N. Y. A 4-page bulletin describes these products, presents a simplified method of selecting them, and lists some typical applications.

Circle **Item 42** on Inquiry Card

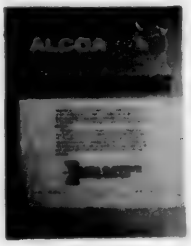


Chart Aids Welding

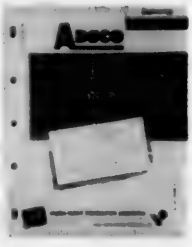
Aluminum Co. of America, Pittsburgh, Pa., announces a welding aid that outlines correct filler alloys for all recommended wrought alloy parent metal combinations. Chart makes filler alloy choices possible based on parent metal combinations and common service requirements.

Circle **Item 43** on Inquiry Card

Insulation Standards

New performance standards for house insulating materials made by the member companies of National Mineral Wool Assn., New York, N. Y., are described in an 8-page booklet which is entitled Mineral Wool Insulation and the All Weather Comfort Standard.

Circle **Item 44** on Inquiry Card



Slip-Type Expansion Joints

Engineering and product information on Adsco slip-type expansion joints are contained in Bulletin No. 57-15B, published by Yuba Heat Transfer Div., Yuba Consolidated Industries, Inc., Honesdale, Pa. Engineering data cover thrust, anchors, thermal expansion, etc.

Circle **Item 45** on Inquiry Card

Solder End Bronze Valves

Solder end bronze valves for Types K, L and M copper tubing installations are manufactured by Stockham Valves & Fittings, Birmingham, Ala., in gate, globe and check models. A 12-page bulletin describes valves with construction features, diagrams and dimensions.

Circle **Item 46** on Inquiry Card

Pipe Bending

How to bend pipe or conduit easily and accurately with its improved Chicago bender is the subject of 4-page Bulletin 260 offered by Lidseen of North Carolina, Inc., Hayesville, N.C. Information includes: Calculating lengths of legs; Locating the bend; Offsets; etc.

Circle **Item 47** on Inquiry Card

Commercial Kitchen Ventilation

This 28-page manual covers the requirements for effective ventilation of all types of kitchens and counter cooking equipment whether the dining area is air conditioned or not. Priced at 50c, manual is available from Order Dept., American Gas Assn., 420 Lexington Avenue, New York 17, New York.

DEGREE-DAYS FOR MAY, 1960

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 32nd Year of Publication of Monthly Degree-Day Data

City	May			Season to May 31, incl., from Sept. 1		
	1960	1959	Normal	1959-60	1958-59	Normal
Abilene, Texas (A)	40	8	0	3048	2834	2707
Albany, New York (A)	152	220	246	6602	7136	6988
Albuquerque, New Mexico (A)	82	60	70	4286	4117	4389
Alpena, Michigan (C)	370	344	437	8321	8043	7803
Anchorage, Alaska (A)	483	530	598	9671	10499	9920
Asheville, North Carolina (C)	181	58	105	4507	4075	4067
Atlanta, Georgia (A)	71	10	20	3226	2797	2826
Atlantic City, New Jersey (C)	157	131	189	4731	5133	4717
Augusta, Georgia (A)	35	5	0	2830	2484	2138
Baltimore, Maryland (C)	84	32	73	4263	4218	4203
Billings, Montana (A)	287	436	304	7015	6834	6959
Binghamton, New York (C)	189	211	240	6013	6815	6472
Birmingham, Alabama (A)	72	12	30	3093	2939	2788
Bismarck, North Dakota (A)	290	397	355	8870	8986	8851
Block Island, Rhode Island (A)	298	276	335	5447	5803	5720
Boise, Idaho (A)	327	382	249	6379	5254	5798
Boston, Massachusetts (A)	165	142	236	5448	5870	5742
Buffalo, New York (A)	235	216	315	6550	6804	6720
Burlington, Iowa (A)	187	110	179	6406	6112	6067
Burlington, Vermont (A)	147	260	307	7495	8055	7727
Cairo, Illinois (C)	97	26	47	4344	3887	3756
Charleston, South Carolina (C)	5	0	0	2203	1851	1769
Charlotte, North Carolina (A)	72	13	29	3512	3203	3205
Chattanooga, Tennessee (A)	129	25	45	3864	3549	3384
Cheyenne, Wyoming (A)	288	441	462	7220	7104	7317
Chicago, Illinois (A)	221	114	229	6361	6249	6252
Cincinnati, Ohio (C)	148	48	108	4798	4467	4532
Cleveland, Ohio (A)	265	133	223	6108	6018	5950
Columbia, Missouri (A)	129	70	135	5628	4971	5093
Columbia South Carolina (A)	38	5	0	2936	2614	2284
Columbus, Ohio (C)	189	92	153	5495	5482	5255
Concord, New Hampshire (A)	201	235	316	6808	7485	7462
Concordia, Kansas (C)	104	109	146	6099	5326	5303
Dallas, Texas (A)	33	0	0	2793	2444	2272
Denver, Colorado (A)	245	273	286	6216	5805	6051
Des Moines, Iowa (A)	153	140	201	7173	6504	6384
Detroit, Michigan (A)	219	159	251	6330	6423	6336
Devils Lake, North Dakota (C)	339	458	394	1019	9753	9695
Dodge City, Kansas (A)	123	108	135	5639	5114	5043
Dubuque, Iowa (A)	259	166	267	7717	7509	7159
Duluth, Minnesota (A)	446	467	487	9639	9685	9217
Elkins, West Virginia (A)	(a)	145	224	(a)	5914	5680
El Paso, Texas (A)	10	3	0	2514	2409	2641
Ely, Nevada (A)	447	537	418	7542	6857	7177
Escanaba, Michigan (C)	446	391	471	9238	8580	8334
Evansville, Indiana (A)	164	58	90	5095	4689	4354
Fairbanks, Alaska (A)	378	544	546	13306	14591	13520
Fargo, North Dakota (A)	276	342	338	9326	8906	9107
Fort Smith, Arkansas (A)	62	11	24	3815	3423	3188
Fort Wayne, Indiana (A)	237	140	226	6458	6383	6217
Fort Worth, Texas (A)	32	4	5	2855	2553	2361
Fresno, California (A)	54	59	43	2392	2032	2532
Galveston, Texas (C)	3	0	0	1573	1332	1211
Grand Junction, Colorado (A)	156	104	145	5753	5076	5773
Grand Rapids, Michigan (A)	254	164	301	2867	7044	6948
Green Bay, Wisconsin (A)	365	213	347	8162	8349	8062
Greensboro, North Carolina (A)	112	33	50	4247	3908	3810
Greenville, South Carolina (A)	87	19	32	3542	3067	3060
Harrisburg, Pennsylvania (A)	171	103	128	5243	5353	5244
Hartford, Connecticut (A)	154	173	201	5914	6361	6094
Havre, Montana (C)	334	407	313	8074	8200	8030
Helena, Montana (A)	(a)	540	399	(a)	7944	9005
Houston, Texas (C)	2	0	0	1655	1430	1276
Huron, South Dakota (A)	259	259	279	8710	7893	7796
Indianapolis, Indiana (A)	214	104	176	6027	5760	5581
Jackson, Mississippi (A)	49	3	0	2861	2839	2202
Juneau, Alaska (A)	470	582	558	7261	8054	7892
Kansas City, Missouri (A)	86	56	111	5361	4613	4880
Knoxville, Tennessee (A)	108	30	50	4027	3637	3590
La Crosse, Wisconsin (A)	196	142	250	7557	7686	7545
Lander, Wyoming (A)	322	487	396	(a)	7581	8110
Lewiston, Maine (O)	230	242	344	6833	7533	7662

a) Data not available.
* Figures based on Airport readings.
** Figures based on City office readings.

Normal figures in this table are based on 30-year period covering 1921 to 1950, inclusive, as compiled and published by the U. S. Weather Bureau.

Figures in this table, with two exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of the Coke Sales Department, Central New York Power Co., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively.

Degree-Days for May, 1960 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING'S 32nd Year of Publication of Monthly Degree-Day Data

City	May			Season to May 31, incl., from Sept. 1		
	1960	1959	Normal	1959-60	1958-59	Normal
Lincoln, Nebraska (C)	131	141	172	6684	5683	5826
Little Rock, Arkansas (A)	64	4	18	3541	3034	2982
Los Angeles, California (C)	24	23	68	913	707	1432
Louisville, Kentucky (A)	151	51	94	4742	4408	4434
Lynchburg, Virginia (A)	146	53	82	4516	4160	4148
Macon, Georgia (A)	33	1	0	2583	2173	2049
Madison, Wisconsin (A)	296	152	266	7787	7669	7181
Marquette, Michigan (C)	507	326	477	8336	8268	8184
Memphis, Tennessee (A)	69	15	24	3589	3219	3137
Meridian, Mississippi (A)	59	2	9	2890	2577	2333
Milwaukee, Wisconsin (A)	402	215	351	7422	7402	7044
Minneapolis, Minnesota (A)	247	192	259	8087	7566	7748
Moline, Illinois (A)	203	114	199	6907	6442	6311
Montgomery, Alabama (A)	43	2	0	2514	2173	2137
Nashville, Tennessee (A)	121	35	43	4223	3757	3513
New Haven, Connecticut (A)	214	193	261	5570	5986	5956
New Orleans, Louisiana (C)	26	0	0	1573	1298	1175
New York, New York (C)	138	129	153	4935	5110	5032
Newark, New Jersey (A)	114	101	148	4844	5152	5241
Norfolk, Virginia (A)	37	37	59	3565	3339	3454
North Platte, Nebraska (A)	242	224	243	7378	6623	6470
Oak Ridge, Tennessee (C)	141	36	58	4210	3916	4028
Oakland, California (A)	174	169	212	2373	2067	2883
Oklahoma City, Oklahoma (A)	73	27	38	4255	3887	3519
Omaha, Nebraska (A)	119	136	175	6896	6083	6123
Parkersburg, West Virginia (C)	183	79	119	5094	5000	4737
Peoria, Illinois (A)	233	103	192	6640	6107	6035
Philadelphia, Pennsylvania (C)	84	70	93	4434	4620	4523
Phoenix, Arizona (A)	0	3	0	1451	1115	1492
Pittsburgh, Pennsylvania (C)	173	95	137	5179	5258	5035
Pittsfield, Massachusetts (A)	252	287	336	7125	7585	7501
Pocatello, Idaho (A)	(a)	472	317	(a)	6283	6840
Portland, Maine (A)	321	295	394	7046	7685	7493
Portland, Oregon (C)	287	259	199	4225	3731	4046
Providence, Rhode Island (A)	196	180	258	5718	6073	6041
Pueblo, Colorado (A)	167	140	203	6085	5400	5682
Raleigh, North Carolina (A)	87	26	29	3868	3546	3075
Rapid City, South Dakota (A)	262	352	357	7759	6941	7331
Reading, Pennsylvania (C)	142	85	123	4970	5137	5044
Red Bluff, California (A)	91	57	51	2476	1920	2546
Reno, Nevada (A)	405	415	318	6009	5431	5783
Richmond, Virginia (A)	88	44	66	4211	3913	3955
Rochester, New York (A)	212	235	289	6773	6973	6766
Roswell, New Mexico (A)	28	11	28	3628	3551	3424
Sacramento, California (C)	73	67	85	2335	1827	2595
St. Joseph, Missouri (A)	107	87	101	6119	5423	4692
St. Louis, Missouri (C)	126	57	94	5052	4519	4462
Salt Lake City, Utah (A)	222	296	233	6142	5263	5785
San Antonio, Texas (A)	7	0	0	1947	1768	1579
San Diego, California (A)	45	25	97	1006	701	1513
Sandusky, Ohio (C)	204	151	217	6028	6081	5818
San Francisco, California (C)	244	247	248	2123	1897	2523
Sault Ste. Marie, Michigan (A)	410	436	499	8803	9231	9016
Savannah, Georgia (A)	15	0	0	2276	1884	1710
Scranton, Pennsylvania (A)	221	167	196	6260	6492	5994
Seattle, Washington (C)	291	280	246	4214	3998	4237
Sheridan, Wyoming (A)	315	488	387	7712	7622	7674
Shreveport, Louisiana (A)	23	0	0	2742	2392	2117
Sioux City, Iowa (A)	161	166	228	7712	6818	6933
Spokane, Washington (A)	420	441	330	7176	6373	6661
Springfield, Illinois (A)	190	89	127	6065	5566	5211
Springfield, Missouri (A)	133	63	118	5167	4589	4669
Syracuse, New York (A)	176	222	247	6574	7016	6454
Toledo, Ohio (A)	244	136	245	6547	6477	6322
Topeka, Kansas (C)	115	92	112	5903	5190	4906
Trenton, New Jersey (C)	106	108	133	4880	5148	5057
Tulsa, Oklahoma (A)	55	20	44	4195	3606	3584
Utica, New York (O)	149	166	253	6142	6883	6796
Valentine, Nebraska (A)	268	315	288	7912	7191	6971
Walla Walla, Washington (C)	236	260	171	5197	4555	4810
Washington, D. C. (A)	103	46	80	4293	4202	4258
Wichita, Kansas (A)	97	62	101	5197	4689	4564
Williston, North Dakota (C)	292	403	360	9009	8850	8859
Winnemucca, Nevada (A)	368	484	299	6682	6038	6241
Yakima, Washington (A)	331	365	205	6265	5804	5785

For footnotes, see page 112

Use the convenient prepaid postcard appearing on the last page for securing additional information about new equipment and materials described in this department.

High-Velocity Room Terminal Unit

A new product developed by Carrier Corp., Syracuse, N.Y., will cut as much as 30% from the cost of room units for high-velocity multi-story building air conditioning systems, according to the company.

Key to the economy of the Bypass Weathermaster unit is a factory-installed and factory-balanced control powered by the conditioned air itself. This control proportions the air flow through the cooling-heating coil while the water flow remains constant. Previous

room terminal units required purchase of separate water flow controls, plus the added costs of pneumatic piping, design time and labor for their installation. The new line also permits separate water flow controls, if desired.

Virtually any requirement can be met with one of six new models for installation under windows, beneath ceilings, or in low window stools. A double coil unit provides extra high sensible cooling and heating capacity.

Further flexibility is offered through a choice of five different nozzle arrangements, matching the variations in load and ventilation requirements of all-glass structures, existing office buildings with moderate glass areas, and hotels, apartments and hospitals with low sensible heat loads and high ventilation needs.

More information? Circle Item 48, postcard, last page.

Extends Fan-Coil Line

McQuay, Inc., Minneapolis, Minn., now offers seven sizes of its Seasonmakers with capacities ranging from 220 to 1240 cfm. These individual room units are of thin-line design, only 8½ inches thin and 25 inches high. They are of compact, modern styling, and require a minimum of installation space. They are especially suitable for apartments, motels, hotels, offices, hospitals, or any installation utilizing a central station heating or cooling system.

Units are made in four models—floor, basic, hideaway and ceiling—each in seven sizes with capacities of 220, 330, 440, 520, 640, 940 and 1240 cfm. The four small sizes are equipped with 1050 rpm motors; and three large sizes have 1500 rpm motors.

Control packages and wall plates for hideaway and ceiling models are available. Coil connections are easily reversed in the field and filters are changeable without removing decorative panels. All units have large piping compartments for easiest installation, and are designed with slide-out fan decks for servicing and for preventive maintenance.

More information? Circle Item 49, postcard, last page.

Fiber Glass Duct Liner

Industrial Insulations Div., Johns-Manville, New York, N. Y., announces a new fiber glass duct liner, called Micro-Bar. Possessing what is described as an exceptionally low fire hazard rating and featuring "dual density" construction for better performance in air conditioning and heating duct systems, the liner, in ½, 1, 1½ and 2-inch thicknesses, is a resilient,

semi-rigid insulation blanket of strong, fine glass fibers bonded by a thermosetting resin. It is made up of two different densities of insulation, each serving an essential function.

The black-colored surface is made of heavy density fiber glass for resistance to the high air velocities of up to 5000 ft per min encountered in modern duct systems. Its toughness, the company points out, makes it easy to form integral nosings at the leading edges when the material is being installed in ducts. This eliminates complicated and costly metal holding strips and metal nosings that dissipate heat. The new type nosing, made of the material itself, is secured with the same type of pin or fastener used to hold the balance of the insulation in position.

Underneath the heavy density surface is the light density portion, amber in color, which provides better sound absorption and overall thermal performance, according to the company.

More information? Circle Item 50, postcard, last page.

New Plastic for Pipe and Duct Withstands 200 Deg F

A vinyl plastic that withstands significantly higher temperatures and pressures has been developed by B. F. Goodrich Chemical Co., Cleveland, Ohio. Tradenamed hi-temp Geon, it is a member of the PVC family and is more technically known as polyvinyl dichloride. The company will supply the raw material to pipe, duct, and various other fabricators.

Important applications, both in residential and industrial construction, are foreseen. According to the company, for the first time there exists a lightweight, heat-resistant, non-corrosive pipe that can be prefabricated into plumbing walls for ready installation by builders, as shown in the accompanying photo of a test installation. Because the material will stand up under 200 deg F, 60 deg higher than is possible with conventional rigid vinyls, piping made of it easily handles service hot water requirements. At 180 deg, the pipe can handle pressures up to 160 psi.

The properties of the new material make it practical for use in severe industrial applications, as the handling of hot acid solutions under such extreme temperatures and pressures as are found in electroplating installations, the company points out. In an industrial trial, the material passed the test of contact with 98% sulphuric acid at 185 deg for 30 days.

Rated as self-extinguishing by American Society for Testing Materials, the new Geon material will not support combustion. Pipe made of it has high mechanical strength, so that it is capable of spanning normal distances between supports in pipe installations. It has sufficient impact strength and resilience to absorb shock and stresses encountered in field handling installations, the company reports.

Because of the relative low conductivity of the pipe, moisture condensation on the outside of cold water lines is considerably eliminated. Pipe can be joined with socket solvent cemented joints or with threaded couplings, and can be cut with an ordinary saw and formed to desired curvature by heating.

More information? Circle Item 51, postcard, last page.

Burner for Nos. 4 and 5 Oils

Model C-45 pressure atomizing oil burner, for use with No. 4 and No. 5 fuel oils, is announced by National Airoil Burner Co., Philadelphia, Pa.

Designed for reliable and economical heating in small and medium sized commercial buildings, apartment houses, etc., and for firing hot water generators or steam boilers, burner has a capacity range of 10 to 33 gph under natural or induced draft, and 15 to 30 gph when firing pressurized furnaces.

Simplicity is one feature which has been stressed, the company states. Other features are: purge of cold oil to nozzle before each start; low-fire start for the larger capacities; enclosed, dust-tight, completely wired, control cabinet; and elimination of air compressors, float chambers, and multiple pistons. Electronic controls supervise its automatic operation.

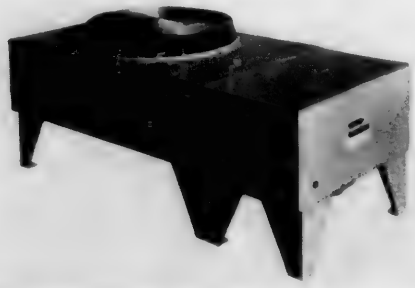
Burner is shipped as a complete unit. No auxiliary equipment is required for No. 4 oil or No. 5 oil where fuel tank is indoors or buried relatively nearby. In cases where tank is at some distance, a small auxiliary pump unit is available for circulating the oil to the burner.

Burner is said to be an excellent unit for the new plant as well as for replacing old installations of rotary and other types of burners, and as a replacement for light oil burners in the range of 15-33 gph.

More information? Circle Item 52, postcard, last page.

Low Silhouette Condensing Unit

Dunham-Bush, Inc., West Hartford, Conn., announces the addition of the "LSCU" (low silhouette condensing unit) to its line of air conditioning products. The unit is available in 5 basic sizes, 10 through 30 tons, and is specifically designed for those air conditioning applications requiring the use of water savers.



Condensing unit is basically a low silhouette blower condenser, complete with a Brunner-Metic motor-compressor, Heat-X liquid receiver, electrical controls and refrigeration accessories mounted in a specially designed section for field attachment or remote installation.

These units can be located anywhere without regard to prevailing winds. The air movement, up and out, is reported to signify minimum noise rating and no objectionable air flow toward neighboring buildings. Enclosures permit easy accessibility for maintenance.

More information? Circle Item 53, postcard, last page.

Airfoil Bladed Fans

A new line of airfoil bladed centrifugal fans which feature a low velocity radial rim wheel design for general ventilation and industrial process applications is available from American-Standard Industrial Div., Detroit, Mich. Designated the Series 116 line, the units are qualified to carry the AMCA Certified Rating Seal for the full range of sizes, Class I through Class III.

Providing what is described as unusually quiet operation, fan is the product of an exhaustive development program. It is available in 15 sizes, in both single and double-inlet designs. The fan is built in accordance with industry sizing standards as outlined in AMCA Bulletin 110, and is available in standard AMCA arrangements.

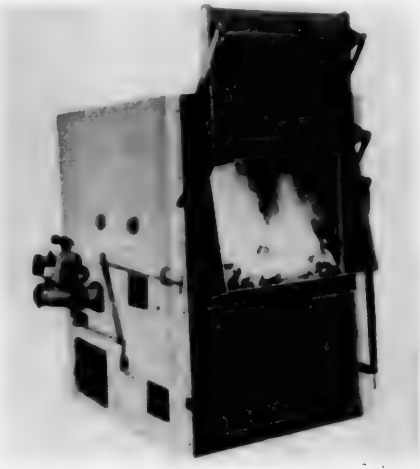
The fans are recommended for use in supply and exhaust systems for ventilation and industrial processes; in air conditioning installations of conventional low velocity, high velocity or double-duct systems; in industrial air conditioning systems; in heavy duty industrial systems; and in ventilation of tunnels for vehicular, pedestrian and railroad traffic.

More information? Circle Item 54, postcard, last page.

Incinerator Is Easy on Operator

The CT destructor, an incinerator with two features designed to make it easy to operate, is offered by Morse Boulger, Inc., New York, N. Y.

The first convenience is a dump-and-shaker lever for removal of fly ash that eliminates constant bending and shoveling. The other is a swing-away charging door which keeps its hot face away from the operator during charging. It is controlled by heavy springs.



Unit has a heavy gage steel outer shell, and insulation-backed firebrick lining. It is 3 ft 8 inches wide; needs only 4 ft for cleaning and stoking. Its verified capacity is 125 lb per hr of Type 1 waste containing 7 to 20% moisture. Incinerator Institute standards for smoke and fly ash requirements have been met.

More information? Circle Item 55, postcard, last page.

Small Blower Wheels

Designed specifically for the new, 14-inch-wide furnaces and compact air conditioners, a line of spun blower wheels is announced by The Lau Blower Co., Dayton, Ohio.

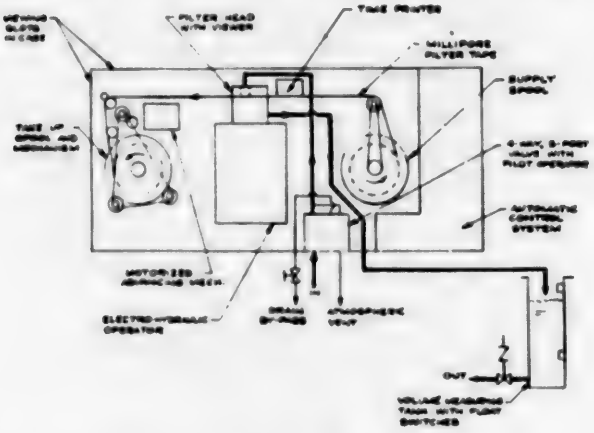
Based on a 4½-inch blade length, the new wheels are the smallest yet produced by the company in the spun wheel style.

With two diameters and two types of back plates, the wheels will be available with both single and double air inlets. They will be powered either by direct drive or belt drive motors.

More information? Circle Item 56, postcard, last page.

Automatic Trace Impurity Detector

An automatic instrument that measures trace quantities of insoluble solids in liquids has been developed by Graver Water Conditioning Co., New York, N. Y. It can be used to monitor the quality of boiler feedwater and condensate in industrial power plants; to



act as quality control for process water and manufactured products in regard to purity and proper ingredient content; to test the ultra-purity of rinse waters, jet and missile fuels, hydraulic fluids in servo systems, and many other applications.

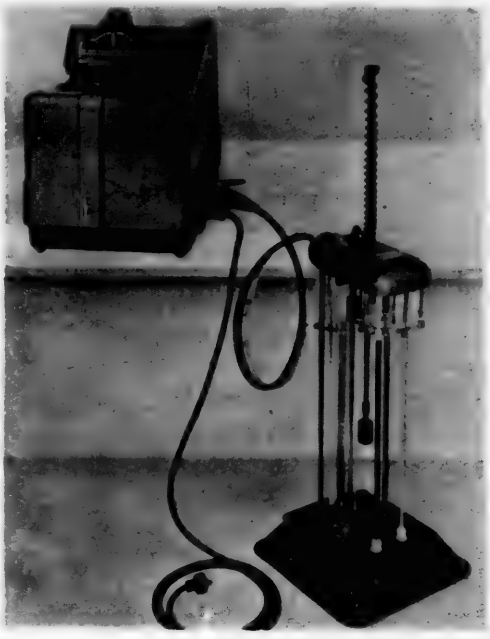
The instrument potentially can be modified to sample plant atmosphere and gases as well as test for solubles and radioactivity. It is so sensitive it can detect two particles of solid impurity in a billion parts of liquid. It is currently being used at Eddystone Station of Philadelphia Electric Company and other power plants to monitor ultra-pure condensate—the purest water ever attained.

Called the Graver Automatic Tape Analyzer, the device derives its versatility from the basic analyzing method it employs—the millipore filter test. In this test, particulate material is quantitatively removed from a liquid or gaseous sample by an ultra-fine Millipore filter membrane and retained on the surface where it may be easily identified, sized, counted or tested.

The tape analyzer automates the Millipore test by filtering samples in sequence as often as desired through a nylon-backed tape of Millipore filter membrane and printing the time each sample is taken. (See schematic drawing.) The basic data produced is a circular stain or discoloration on the tape made by the solids extracted from the filtered fluid. The degree of discoloration, proportionate to the insoluble solids concentration, can be calibrated by analyzing a portion of a sample and then running another portion through the tape analyzer. A strip-chart recording attachment is also available.

The Millipore tape has an effective porosity of 450 millimicrons. It filters parts per billion trace solids and shows distinctly on the tape concentrations as low as 2-4 parts per billion. The instrument housing the tape is of simple design and is only slightly larger than an office adding machine. (See photo.) A modern, fiberglass covering cabinet contains a viewing window and operating controls.

The current Model 302, now in production and available on order, is a basic unit which can be modified in many ways to increase its usefulness. For example, radiation monitors can be incorporated for nuclear applications, reflectance measuring devices can be added to give more exact readings, other instruments can be mounted to give a variety of data, and modifications can be made in design and construction according to the requirements of specific applications.



Millipore tapes with porosities smaller and larger than 450 millimicrons can also be used.

Long-term prototype tests and actual operating data confirm the instrument's ability to go through its cycles day and night with no attention required. Beside its rugged construction, the unit is portable and can be placed on many types of service.

More information? Circle Item 57, postcard, last page.

High Capacity Grille

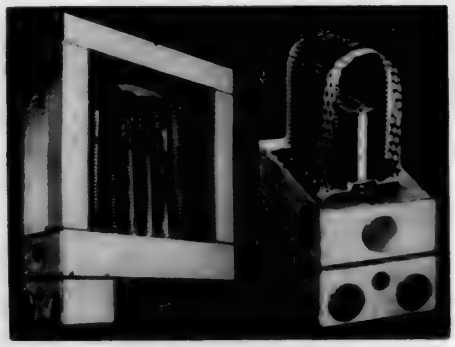
Low-cost horizontal grilles, Series 18H, with curved louvers said to offer maximum free area, are announced by Lima Register Co., Lima, Ohio. They are recommended by the manufacturer for air conditioning, return-air, ventilation, or combustion air applications.

Entire grille is made from a solid piece of 19-gage steel. Curved, ½-inch horizontal louvers, spaced ½ inch apart, are designed to offer high volume at low noise level, the company states. Sizes from 10 by 6 to 30 by 24 inches, enameled.

More information? Circle Item 58, postcard, last page.

Electric Airduct Heaters

Two electric airduct heaters are announced by Edwin L. Wiegand Co., Pittsburgh, Pa. Chromalox Type FFT has been designed for installation in existing ductwork; Type FTD for installation as part of new ductwork.



Both types feature Chromalox Fintube metal-sheathed elements which have ceramic coatings that prevent corrosion, even after long exposure to high-humidity summer air, the company states. Both, also, have heavy-gage, corrosion-resistant terminal boxes and frame parts spot-welded into a rigid assembly.

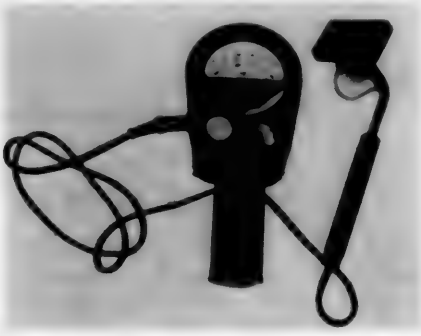
Capacities range from 2 to 100 kw with voltage ratings from 120 to 550.

More information? Circle Item 59, postcard, last page.

Thermometer for Moving Objects

The Gelman-Wallac rotating object thermometer allows measuring surface temperature without actual contact of the probe with a surface. Temperatures of processing rollers and drums can be accurately measured without introducing errors due to friction, states the manufacturer, Gelman Instrument Co., Chelsea, Mich.

This special thermometer consists of a resistance sensing head and a battery operated temperature indicator. In use the probe is positioned about 0.003 inch from the surface to be measured. Conduction losses of the surface heat the sensitive resistance element. Errors which would be introduced by conduction losses only are automatically compensated by means of a built-in parabolic reflector behind the element.



Temperature indicating unit is small enough to be held in the operators hand. It operates from a single flashlight battery and indicates temperature directly on a calibrated dial. The thermometer can be used up to 450 deg F.

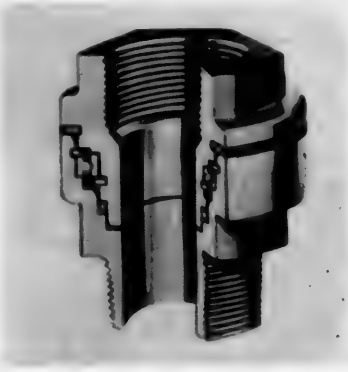
Panel mounted versions of this same instrument are also available.

More information? Circle Item 60, postcard, last page.

Ball Bearing Hose Swivel

A hose swivel, with steel ball bearings, is introduced by OPW-Jordan Corp., Cincinnati, Ohio.

Used on liquid lines in general industrial applications where easy swiveling action is necessary, the new unit revolves freely at pressures up to 125 psi and temperatures to 225 deg F. The No. 20 hose swivel can be used



to make piping and tubing flexible or movable, or as swivel connectors on hose to eliminate damage due to twisting. Ball bearing design enables the swivel to withstand severe radial and thrust forces.

Available in 1¼ and 1½-inch sizes, swivel is made leak proof by a Buna-N O-ring. Construction is of bronze and aluminum. Ball bearing races are locked in by snap rings without hindering swivel action. Dust seal keeps dirt and dust out of ball bearings and races, assuring constant free-turning action, the company says.

More information? Circle Item 61, postcard, last page.

Expands Heating Boiler Line

Federal Boiler Co., Midland Park, N. J., announces the re-design and expansion of its entire commercial-industrial heating boiler line. It now offers a complete selection of more than 88 sizes and models.

The new boilers range in sizes from 1780 through 64280 sq ft steam, and are available in gas- and oil-fired models.

The re-designed models are in three series: FLW low water line boilers; FLR horizontal fire tube boilers; and FMA and FMB Scotch marine boilers. All incorporate new design advantages including rugged door designs, increased efficiency in insulating properties, improve windbox design for the burning of modern fuels, and increased efficiency in combustion.

More information? Circle Item 62, postcard, last page.

Sets Ruling Pen Line Width

A jack-knife arrangement of 25 flat steel feelers, ranging in thickness from 0.0015 to 0.025 inch for insertion between drawing pen blades during adjustment, is offered by Laramie Chemical Corp., Stamford, Conn.

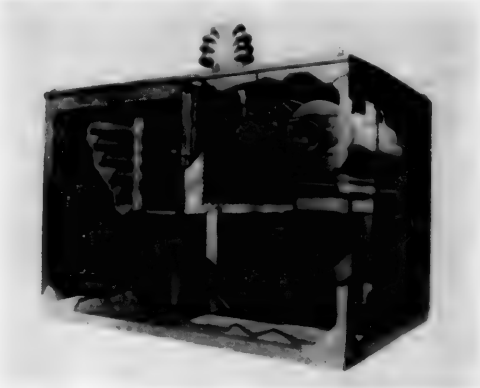
Called the LineMan, it assures an ink line of consistent width and will match line with line, pen with compass, new work with old, and insure uniformity in drawings from department to department.

More information? Circle Item 63, postcard, last page.

Heating-Cooling Roof Top Units

A line of heating and cooling equipment for outdoor mounting has been introduced by The Mammoth Furnace Co., Minneapolis, Minn. The Compact-Aire and Commercial-Aire roof top series are available in six basic sizes for gas or oil firing in outputs from 150,000 to 1,000,000 Btu per hr.

The YR unit is completely enclosed in a weatherproofed housing. Key-locked doors offer access to the



vestibule which houses the control panel, burner and access panels for servicing the component parts. Two sets of multi-louver dampers control the air mixture which can vary from 100% fresh air to 100% return air, or any desired ratio between the two extremes. Turning vanes are strategically placed throughout the unit for maximum air wipeage with minimum resistance.

Roof top unit is designed to accommodate any standard make of cooling equipment from 2 to 40 tons, and uses either air or water-cooled condensing units. The units are available as a complete heating-cooling package or as heating only for future field addition of the cooling cycle.

More information? Circle Item 64, postcard, last page.

Stainless Steel Pressure Controls

The Mercoid Corp., Chicago, Ill., announces a new series of pressure controls which are reported to offer a wide range of application in many fields. All parts of the control in direct contact with the pressure medium are made of Type 316 stainless steel.

Control has outside adjustments for easy setting (without tools) of operating points. Visible calibration feature tells at a glance exact operating points at which control is set. Hermetically-sealed mercury contact, also visible, provides a quick means of determining whether circuit is on or off.

Control is available in a variety of operating ranges and NEMA constructions.

More information? Circle Item 65, postcard, last page.

Single Control By-Pass Valve

A single control by-pass valve, which eliminates intricate piping connections for induction and fan-coil air conditioning systems, is designed by Clayton Mark & Co., Evanston, Ill.

Saving space, materials, and labor, one compact casting combines the functions of inlet and outlet stop valves and the by-pass or flushing valve which normally are installed at each coil in a central air conditioning system. One 90-degree turn of the control handle on the valve opens the by-pass and shuts off the water supply to coil and thermostatic control.

The valve is designed to replace the three-unit valve cluster which normally is installed at each coil so that pipelines can be flushed prior to putting the system in operation. With a large office building or hotel requiring the setting of hundreds of by-passes when pipes are to be flushed, the valve's labor-saving advantage will multiply rapidly, according to the company. It also provides convenience when an individual unit in the air conditioning system must be turned off for repair or maintenance.

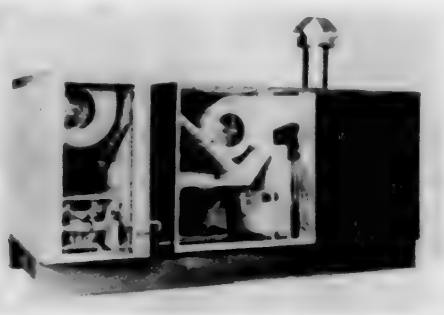
Valve, designated No. 1831, measures 2-1/16 by 2-5/16 inches, and requires only 14 cubic inches of space. It is available in sizes to accommodate ½ or ⅝ inch OD copper tubing with either soldered or flare type connections.

More information? Circle Item 66, postcard, last page.

Roof Mounted Conditioner

A 15-ton packaged air conditioner designed for roof mounting is introduced by Ventil-Aire Corp., Brooklyn, N. Y. Unit provides a year-round system for commercial and industrial buildings with large economies in installation and operation, the company reports.

The air-cooled packaged unit incorporates efficient, gas or oil fired furnaces producing up to 400,000 Btu per hr output.



This unit is in addition to the 5, 7½, and 10-ton units introduced by the company late in 1958. Three separate unit designs permit installations to a complete duct system or installation directly above the conditioned space through short co-axial ducts and diffusers furnished with the unit. New cabinet alloys permit location of equipment close to seashore areas.

More information? Circle Item 67, postcard, last page.

Beading Kit for Glass Piping

With a beading kit introduced by Corning Glass Works, Corning, N. Y., glass process piping and drainlines can be fabricated at the job site. Kit includes all the equipment needed to score and cut Pyrex Brand piping and Lifetime drainlines to specified lengths, and to bead section ends

for making permanent compression joints. Its use requires a minimum of instruction.

Field fabrication permits the contractor or plumber to make non-standard lengths of piping. Use of this equipment, according to Corning, eliminates the need for ordering custom-made sections.

A single cutting device and one burner can be used on all sizes of piping—from one to six inches in diameter. Piping is scored internally and flames are applied to the outside to achieve a clean break. The heat source is a combination of oxygen and "bottled" or natural gas. Equipment is supplied in an easily carried steel case. Kit is available for purchase or rental.

More information? Circle Item 68, postcard, last page.

Drain System for Corrosive Waste

Development of a non-corroding drain line system for public buildings, industries and institutions is announced by The Dow Chemical Co., Midland, Mich. The system makes use of Saran lined pipe and simplified fittings of ductile iron.

Fittings are designed for ease of installation and

service between normal wall partitions. Union type fittings are used with round connector nuts that can be tightened with a spanner wrench. Dow engineers state that the installation can be accomplished with a simple O-ring gasket without caulking.

System was designed both to simplify the plumber's job in tight quarters and to meet needs, in new or old buildings, for laboratories, hospitals and industries with corrosive waste to drain. It will permit piping of waste acids, alkalies or solvents through Saran lined pipe and steel all the way from the sink to ceramic waste sewers. Line and pipe sizes to be marketed are 1½, 2, 3, 4, and 6 inches.

More information? Circle Item 69, postcard, last page.

Finer Filtering Media

Owens-Corning Fiberglas Corp., Toledo, Ohio, announces Fiberglas air filter, Type 004-12, for specialty applications in high efficiency air filtration.

Said to be the finest filtering media produced for commercial purposes, the material is designed for use where a higher than normal degree of air cleaning is required.

Performance of the new filtering media is equivalent to that of the electrostatic method of air cleaning, the company reports; however, it can be used in certain applications for which the electrostatic method is not suitable.

More information? Circle Item 70, postcard, last page.

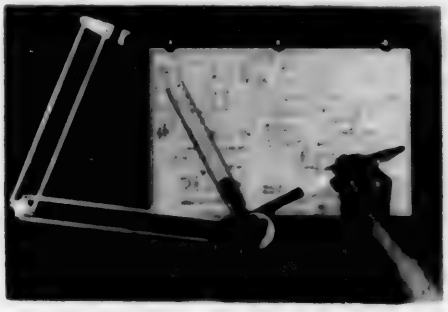
Non-Scald Shower Valve

The Super Safetymix is described as a foolproof valve with fingertip controls for both temperature and volume by the manufacturer, Symmons Engineering Co., Boston, Mass. The lever-type temperature control handle has incorporated in it a knob for dialing the desired volume of water. This eliminates awkward fumbling in the shower for the right adjustment.

Unit has a leak-proof seal as well as built-in, self-cleaning action. This permits effective use, even in areas where the water has a high mineral content. The leak-proof spindle seal should never require replacement, the company states. Said to be the simplest valve ever devised for accurate control of shower water temperature, it is as easy to fix as a faucet.
More information? Circle Item 71, postcard, last page.

Portable Drafting Machines

Addition of Models 112 A and 112 M portable drafting machines is announced by Drafting Equipment Co., Meadville, Pa. Model 112 M has two 9-inch scales graduated in inches, 32 divisions to the inch, and are reversible for full- and half-scale drawing. Model 112 A



is for architectural work. Its reversible anodized aluminum scales are graduated ⅛, ¼, ½, and 1 inch per foot.

The complete machine consists of three demountable units: (1) board, (2) parallel arm assembly and (3) protractor complete with scales. The 15 x 20-inch tempered hardboard is equipped with three circular paper clamps which offer minimum interference to the vertical scale. Four 13-inch long chrome-plated arms of the parallel mechanism, plus the off-corner mounting combine to provide easy coverage of the entire board surface with both vertical and horizontal scales, the company says. Protractor parts are aluminum, anodized for hardness. Machines are sold on a ten day trial period.
More information? Circle Item 72, postcard, last page.

Sound Dampener for Piping

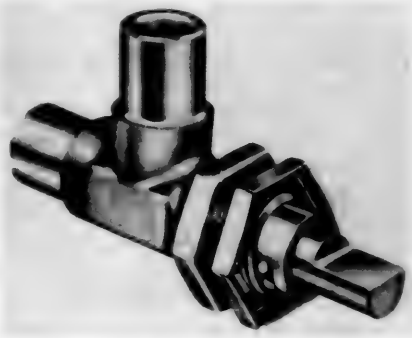
A new line of combination pipe hangers and sound isolators is being manufactured by Elcen Metal Products Co., Franklin Park, Ill. The hangers can be used for both standard pipe and copper tubing sizes ranging from ⅜ to 6 inches. The isolator is factory installed to the hanger to help eliminate the field labor cost.

The isolator is reported to eliminate the sound and vibration generated by movement of pipe by expansion, contraction, flow of liquids through piping, or by equipment such as pumps, compressors, valves or regulators. The isolator prevents the transmission of vibrations to the building structure; it also can be used to eliminate the possibility of electrolytic action.

Isolator is made of a galvanized sheet metal cover, formed with reinforcing ribbing, and a chemically-processed high-compression felt is permanently attached to this cover. Special stainless or aluminum covers can be made where high corrosive and other conditions exist.
More information? Circle Item 73, postcard, last page.

Control Valve for Hoses

To meter flow of water in small diameter hose and tubing applications, Robert Mfg. Co., Los Angeles, Calif.,



has introduced a brass metering control valve. Turning the valve stem through 180° controls the valve from full flow to maximum restriction.

The stem end of the valve can be used with or without a knob. Without the knob a permanent setting can be maintained. The valve is available in various sizes.
More information? Circle Item 74, postcard, last page.

Flexible Wedge Disc Gate Valves

Crane Co., Chicago, Ill., introduces a line of 150- and 300-pound steel gate valves with a new flexible wedge disc. According to the firm, this disc marks the most significant gate valve improvement in 25 years. The registered name of the line will be Flex Gate.

The working pressure of the 150-pound valve ranges from 40 psi at 1000 deg F to 275 psi at 100 deg. The 300-pound valve has a range from 85 to 720 psi at a similar temperature range.

At no increase in price over conventional solid wedge disc gate valves, the new valve is reported to offer many advantages, especially for rugged service in oil refineries, power, chemical, paper and other modern industrial plants.

Valves operate easily, even if closed while hot and then permitted to cool. As the body seat pinches the disc, it flexes slightly to conform to the new seating position. Flex Gates do not stick closed; they seat and unseat with minimum torque. The flexible wedge disc also compensates for minor misalignment of seats due to pipeline deflections.

More information? Circle Item 75, postcard, last page.

Mobile Home Heating Unit

This compact electric furnace, specifically designed for mobile home heating, can be installed in minutes, according to Ramco Manufacturing and Engineering, Portland, Ore.

Engineered for complete safety, the unit boasts advantages of no flame, no soot, no combustion; no open-coil elements; and no build-up of residual heat. Continuous cycling action and quiet operation make it hard to tell, the company states, when the furnace is actually running.

Furnace specifications include: rating of 8 kw, 230 v, 33.2 amps; output of 27,304 Btu per hr; weight of 80 lb net; and dimensions comprising 30 by 21 by 15 inches.

Fan rating is 750 rpm at 1.2 static pressure, 120 v, 1/12 hp, with variable fan speed control.

More information? Circle Item 76, postcard, last page.

Tank-Type Water Softeners

What is described as the most complete line of tank-type water softeners available to the restaurant field has been introduced by Calgon Co., Div. of Hagan Chemicals & Controls, Inc., Pittsburgh, Pa.

The softeners range in size from one of 15,000-grain capacity to units that will handle a flow of 150 gallons of water per minute with a softening capacity of 900,000 grains of hardness minerals before automatically recharging. The softeners are fully automatic and designed for maintenance-free operation. Softener and brine tanks are fabricated from hot dip galvanized metal.

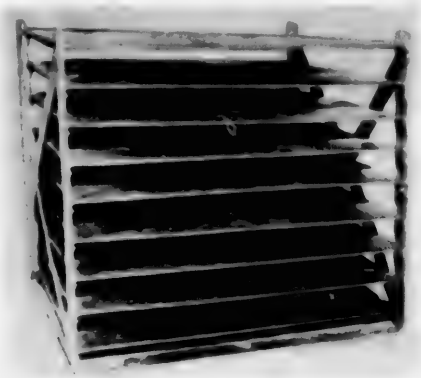
The company reports that soft water offers many advantages to the restaurant operator. Maintenance costs are lowered because lime scale is eliminated. For instance, final rinse nozzles in the dishwasher will operate with continued maximum efficiency without plugging, and scale will not form in coffee urns, water heating equipment, and water lines. In addition, soft water is said to provide special benefits in food preparation.

More information? Circle Item 77, postcard, last page.

Electric Duct Heater

An oven-type, electric plate heater bank assembly for air conditioning ducts is announced by Electric Heater Specialty Co., New York, N. Y. Designated Model 2-PO-AD, the heater is said to provide high capacity, low-density heat exchange with fast heat-up and minimum restriction to air flow.

Heater bank assembly, consisting of flat-plate heaters sturdily mounted in tandem, can be made in varying heights, lengths and widths for installation in any size duct. All heater surfaces are plated sheet steel and are electrically insulated. Heater plate thicknesses are 3/16 inch. The distance between plates is determined by heating requirements.



A total of 3510 sq in. of heat-exchange surface per 10-kw capacity can be provided in 2535 cu in. Heater banks can be connected for single phase or 3-phase, 208 volts, 220 volts or 440 volts. Heating coils are mica-insulated from the sheet-steel plate coverings. Heater banks are electrical-hazard proof and shock-proof.

The assembly is recommended where high capacity, zone-controlled heat-exchange is required; 20-kw, 30-kw or 40-kw heater banks can be installed in minimum duct space where air of different temperatures at different points on the same duct may be required. The heater bank is easily installed in existing air duct systems, the company states.

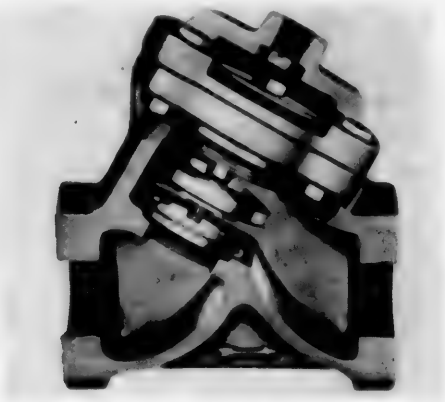
More information? Circle Item 78, postcard, last page.

Line Pressure Operates Valve

A line of diaphragm valves that are operated by line pressure is introduced by AquaMatic, Inc., Rockford, Illinois.

The principal feature is a simple and reliable diaphragm actuator, working directly off actual line pressure, which functions positively in both directions without the use of springs or other auxiliary forces. Valves are available in ¾, 1, 1¼, 1½, 2 and 2½ inch sizes. All are screw type with cast iron bodies, hot dip galvanized in sizes under 1½ inches. Larger flange-type sizes are in development.

Simplicity, power, and reliability of the diaphragm arrangement are said to characterize these valves. The diaphragm, which is of Neoprene reinforced with nylon,



is attached to the solid stem shaft which slides through a hole in a solid barrier plate and carries the valve disc on its lower end. An O-ring in the shaft hole is carefully engineered to hold against pressures far in excess of any likely to be encountered, thus providing a leak-proof separation for the diaphragm chamber. Line pressure, applied above the diaphragm through a ¼-inch line and control valve (of any desired type, manual or powered), forces the diaphragm, stem, and disc down to close the valve on the seat. The disc is held positively closed because the area of line pressure on the diaphragm is larger than the area of line pressure against the disc and seat.

When pressure is removed from above the diaphragm, the pressure in the line against the disc immediately pushes it up to the wide-open position. A feature which permits easy operation of the diaphragm, when opening or closing the valve, is an open air vent for the lower chamber between the diaphragm and the barrier plate.

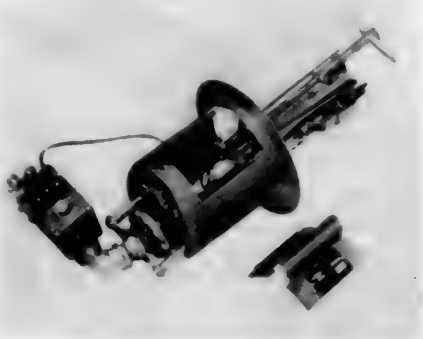
Low pressure loss is obtained by minimum obstruction and deviation of the flow through the valve. The seat is large in diameter, the disc has a high rise from the seat, and the angle of the seat has been determined, by careful experiment, to be that which results in the least turbulence. All passages inside the valve are generous in size and smoothly contoured.

Among applications suggested by the manufacturer are: as service valves on a wide variety of water-conditioning or ion-exchange equipment, as remote controls in large or small lawn-sprinkling systems, in automatic circuits, on many types of process equipment, for the control of air or gas in numerous applications where power operation or remote control is specified, as replacement for various other types of power-operated valves which now have clumsy or elaborate actuators, and probably in a number of applications which even the designers have not envisioned at the present time.

More information? Circle Item 79, postcard, last page.

Telescoping Mixer Tube

Simplified installation is called one of the many advantages of the telescoping mixer tube now offered with the company's atmospheric type (400-R Series) and blower type (450-P Series) gas conversion burners. According to



Roberts-Gordon Appliance Corp., Buffalo, N.Y., these inshot burners are quickly and easily installed in a wide variety of oil designed heating equipment due to the adjustability of the mixer tubes.

Further savings are achieved, the company reports, through increased combustion efficiency. The telescoping mixer tube makes it possible to accurately position the burner port and the flame spreader in the proper relation to the combustion air stream. Thus, the flame conforms to the shape of the combustion chamber for maximum heat transfer, giving greater fuel economy.

More information? Circle Item 80, postcard, last page.

Corrosion Inhibitors

Two polyphosphate-chromate corrosion inhibitors, announced by Dearborn Chemical Co., Chicago, Ill., feature a new organic additive, Endcor A, that is said to provide improved control of corrosion and deposits.

Polychrome 501 is intended primarily for use in open recirculating systems employing heat exchangers that appreciably raise the temperature of the cooling water. Polychrome 505 is recommended for use primarily in open recirculating systems when relatively low temperatures are encountered.

According to the manufacturer, the organic additive bolsters protective films and has surface active properties which interfere with carbonate and phosphate deposit formation. As a result, pH of cooling water can be higher, and smaller amounts of acids are required.

More information? Circle Item 81, postcard, last page.

Copper Brushing Machine

A time and labor saving copper machine is announced by The Oster Mfg. Co., Wickliffe, Ohio. Called the No. 10 Copper Brushing Machine, it is a low cost, lightweight, one-man unit, designed to meet the needs of cleaning

copper tubes and fittings on even small installations.

Machine cleans the inside diameter of fittings, and deburrs and cleans the outside diameter of tubing by power, thereby eliminating slow, tedious hand operations. Capacity is ½ through 4 inches.

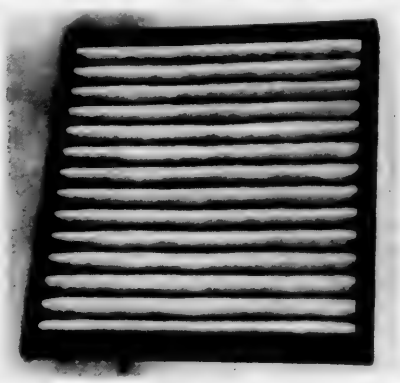
Machine can be furnished either for bench mounting or with legs. To assist in supporting longer lengths of tubing, an outboard pipe rest stand is available.

More information? Circle Item 82, postcard, last page.

Filters Hold More Dust

Pure-Air extended surface filters, consisting of 2-inch high pleats set on 1¼-inch centers, are announced by Arco Mfg. Corp., New York, N.Y. According to the company, effective filter area is four times that of the glass fiber throw-away filter and, as a consequence, it will out-last an ordinary throw-away filter many times.

Under the influence of the air stream, each filter pleat becomes a parabolic pocket, the company states.



Because of this shape, the least resistance to air flow is at the back of the pocket, the resistance gradually increasing up the sides of the pocket. Large dirt particles, because of their inertia, cannot change direction therefore lodge at the back of the pocket. The fine particles are deposited on the sides. The air travels through the sides of the pocket at an angle, going through a much greater thickness of material, thereby increasing filtering efficiency.

Extended surface filters are said to have a far greater dust arrestance than ordinary viscous coated filters, will fit into all types of filter banks, require no investment in cages or baskets or other supporting devices, and, because an un-oiled filter media is used, eliminate the risk of ceiling discoloration caused by entrained oil in the air stream.

Available in all 2-inch standard sizes.

More information? Circle Item 83, postcard, last page.

Metering Shower Saves Water

A metering shower said to save up to two-thirds the amount of water usually consumed in taking a shower is introduced by Speakman Co., Wilmington, Del. Called Easy Push, the self-closing metering shower has an adjustable metering valve with an integral, key-operated volume control for regulating the water supply.

When the handle is pressed down with the finger tips, the shower gives up to 4½ gpm of tempered water and then shuts off automatically. Water is not wasted while the user is soaping. Ready to rinse off, the user presses the handle once or twice more and the shower is completed.

Total water consumption is 4 to 6 gal, compared with 12 to 18 gal that would have been used with a conventional shower fixture.

For areas where water is at a premium or in short supply during dry months, the metering shower offers savings to homes, hotels, motels, industrial plants, schools and other institutions which have multiple shower installations.

More information? Circle Item 84, postcard, last page.

(Continued on page 127)

custom tailoring costs less than "ready-to-wear"

Buying an electric motor with "ready-made" insulation can be a costly luxury.

Motor operating conditions vary so widely throughout industry that Fairbanks-Morse insulation systems are *tailored* to actual operating conditions . . . not *standardized* to "the average".

"Ready-made" insulation systems are an "across-the-board" compromise with *average* operating conditions. When *your* case is the all-too-frequent exception, the compromise is costly.

Even in "hard to fit" cases we build motors rated, dimensioned and insulated to furnish unfailing power. Insulating materials are carefully tested, selected, treated and prepared so that insulation as well as motor enclosure is *matched* to the job. Entire insulation system is custom tailored to meet emergency overloads, temperature extremes, corrosive atmospheric conditions . . . whatever combination of factors affects motor life and performance of your *specific* operation.

This *flexible* application of varied insulating materials and processes "pays off" in low maintenance, uninterrupted production, prolonged service.

Whatever your motor needs . . . 1 hp or 10,000 hp . . . open or weather-protected . . . vertical or horizontal . . . synchronous or induction . . . AC or DC . . . Fairbanks-Morse builds it, builds it right, builds it to last. Get the facts . . . drop a line today to: Fairbanks, Morse & Co., Freeport, Illinois.

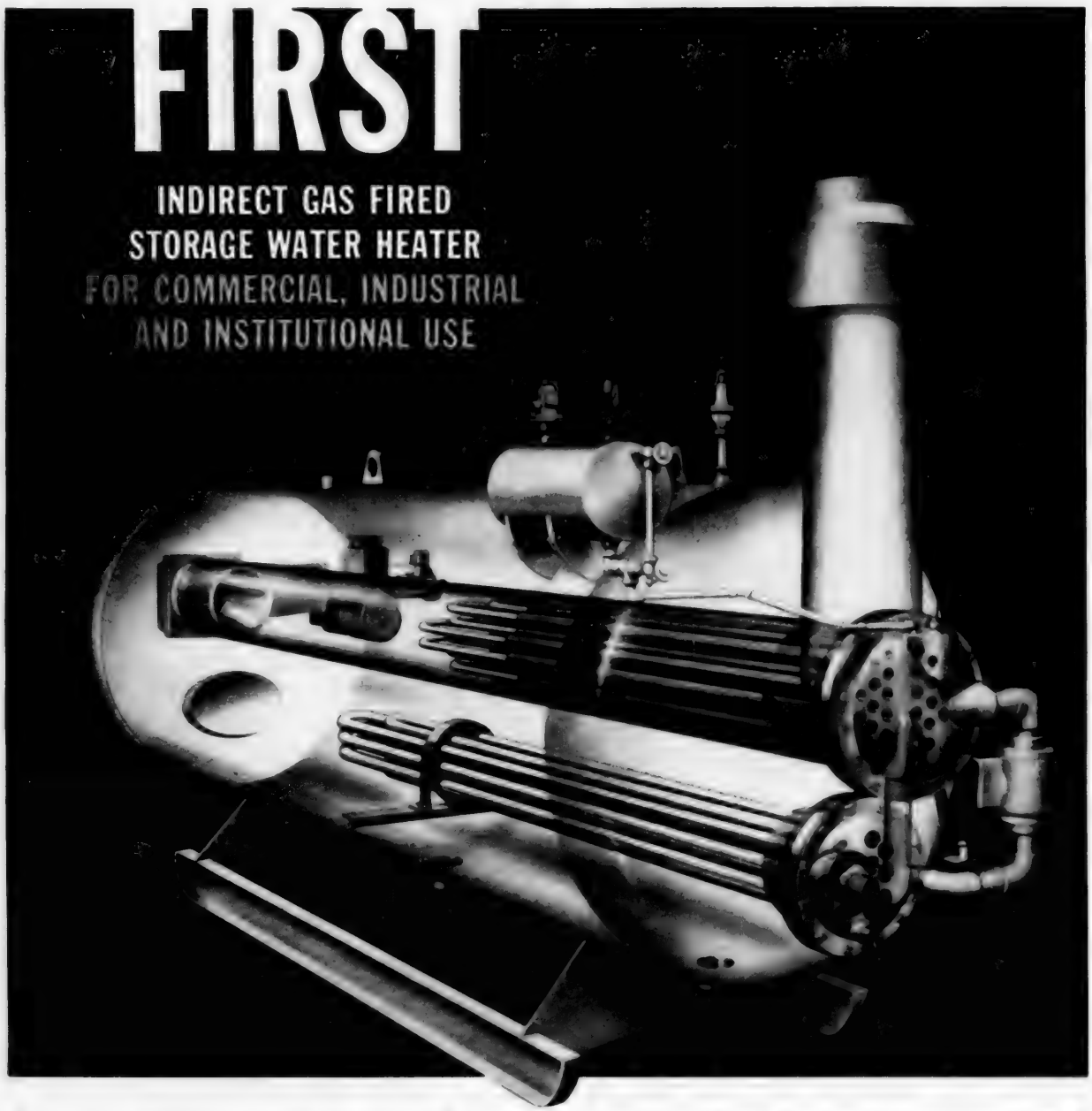
Fairbanks, Morse

ELECTRICAL DIVISION

A MAJOR INDUSTRIAL COMPONENT OF FAIRBANKS WHITNEY CORPORATION

FIRST

INDIRECT GAS FIRED STORAGE WATER HEATER FOR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL USE



No scaling • No drop-off in rated efficiency • No fuel waste • No on-the-job assembly • No complicated maintenance • No limitations on placement • Fully automatic • Copper heating surface

P-K SCALEFREE 230* is a unique rugged unit backed by P-K's 80 years of experience in building and designing quality water heating equipment. It heats water through hot intermediate distilled water. Transfer occurs below the temperature at which minerals that cause scaling precipitate. Efficiency remains unimpaired throughout service life. Linings of pre-Krete or copper are available to keep the unit free of rust and corrosion regardless of water conditions.

SCALEFREE 230 features a new P-K gas burner. It operates at maximum practical efficiency. Yet it gives almost noiseless service—does not rumble or boom on startup. This permits location almost anywhere in office buildings, institutions, schools, motels, etc.

SCALEFREE 230 is a complete fully automatic package that can be quickly set in place, hooked up and checked out. It is available in more than 100 storage and recovery combinations. Storage capacities range from 250 to 4000 gallons. Recovery sections range from 390,000 to 2,215,000 Btu. Write for catalog with full information.

*Patent pending

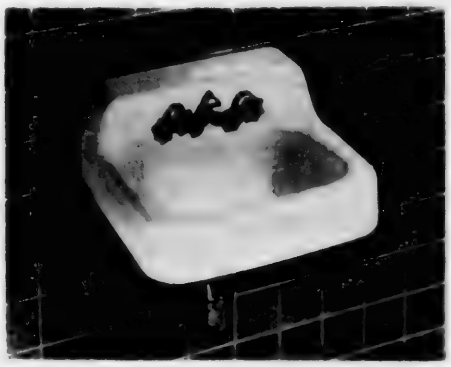
Patterson Kelley

101 Morgan Avenue, East Stroudsburg, Pa.

(Continued from page 124)

Enameled Cast Iron Lavatory

An enameled cast iron lavatory, based on latest design and utility trends, is announced by American-Standard Plumbing & Heating Div., New York, N.Y. Known as the New Ledgewood, the lavatory offers high style for budget installations, the company reports.

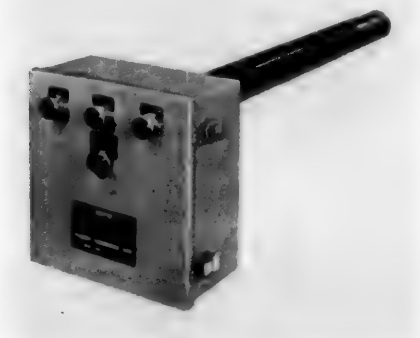


The lavatory is available in two convenient sizes—22 x 19 inches and 19 x 17 inches. Adequate space for toiletries is provided by a 4-inch shelf. The ledge-back design prevents water from splashing on the wall. A concealed front overflow, spacious 6-bowl depth, and Heritage or Colony fittings with a pop-up drain are other features of the lavatory. Called ideal for residential installations, the fixture is also suitable for commercial use.

More information? Circle Item 85, postcard, last page.

Self-Proving Gas-Electric Ignitor

Peabody Engineering Corp., New York, N.Y. announces Series "FP" gas-electric ignitor with integral flame proving, called an important addition to Peabody fuel burning equipment. The product of an extensive research, development and field testing program, the new unit satisfies the need for a gas-electric ignitor that will perform safely and dependably under all operating conditions. Its simple, rugged, compact



design permits major cost savings in installation and maintenance, the company reports. This ignitor functions ideally as the "heart" of automatic burner light-off, remote control and safety-sequence systems.

Designed for use with boilers, flares, fuel vents and for other service, this ignitor will light, stay lighted, and prove it is lighted even under the most adverse ignition conditions. It is universally applicable to all types of large industrial fuel burners and to various types of firing. Complete flexibility of the unit adapts it to any sequence of safety or remote control.

The ignitor, for 1 to 5 million Btu per hr capacity, operates with gas at pressures from 1 to 15 psig. Both transformer and spark cut out when ignitor flame is established, eliminating transformer and electrode maintenance. The unit may be used with atmospheric or pressurized furnaces. If desired it can be removed from a furnace while the furnace is under pressure.

More information? Circle Item 86, postcard, last page.

Sweep Balance Btu Meter

A sweep balance Btu meter, designed for accurate assessment of heating or cooling costs on the basis of recorded consumption in either commercial or industrial applications, has been developed by Air Conditioning Equipment Corp., New York, N.Y.

The function of a Btu meter in a heating or cooling system is to measure the volume or weight of the heating or cooling fluid, and determine the temperature difference between the fluid entering and the fluid leaving the system. Computing the product of these two factors provides total Btu or the exact quantity of heat removed or added.

Together, the mechanical meter and the new sweep balance meter provide an application range for Btu meters that includes virtually any situation in which charges for heating or cooling are to be based on recorded consumption, rather than on some inexact measurement such as space occupied.

The sweep balance meter is simpler in design than other Btu meters, the company states. For example, it requires no amplifiers. It employs electrical resistance thermometers and a unique electromechanical computing device. Turbine-type flow meters make possible high counting accuracy over the full range of flow rate.

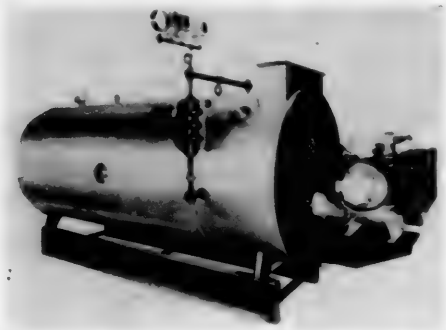
As a result of what is called exceptional temperature sensitivity, the new meter can be used for cooling systems where the temperature difference is only a few degrees Fahrenheit. With the meter it is even possible to use just one instrument for both heating and cooling with a single system. In this case heating and cooling measurement would be indicated on separate dials.

More information? Circle Item 87, postcard, last page.

Boiler-Burner Plants

Availability of Highlander boiler-burner plants in 21 sizes is announced by Industrial Combustion, Inc., Milwaukee, Wis.

The Scotch-type, two-pass units utilize one of the company's heavy-duty oil, gas, or combination burners for No. 4, 5, or 6 oil burning from 5 to 150 gpm, or



for gas burning from 720,000 to 21 million Btu. One combination burner handles 5 to 150 gph of light oil and 720,000 to 21 million Btu gas; another handles the same amount of heavy oil with the same gas-burning capacity. Changeover is accomplished, in most models, with a flip of a switch.

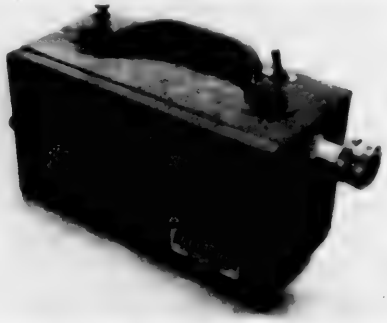
The complete plant is manufactured to ASME standards for low, 125 lb, or 150 lb steam pressures in capacities from 10 to 460 hp. Output ratings are SBI certified.

More information? Circle Item 88, postcard, last page.

Sampler Speeds Dust Surveys

An air sampler called the Bantam Sampler is offered by Gelman Instrument Co., Chelsea, Mich. It weighs 9 lb and samples air at the rate of 2 cfm.

This air sampler fills the need for a light weight, easily portable unit with a high air capacity the company states. Its centrifugal carbon vane pump unit never requires lubrication. The universal motor which drives the pump has been designed to pack the most power in the smallest package. A built-in fan and louvered metal case provide



air circulation to keep the pump cool. The case protects it from rough handling and accidental dropping.

Flowmeter is directly calibrated in liters per minute. The sampler is supplied with a 1-inch open filter holder. This can easily be connected to the pump by means of a new polyethylene press fit coupling. There is nothing to wear out or get out of adjustment. An on-off switch is an additional convenience.

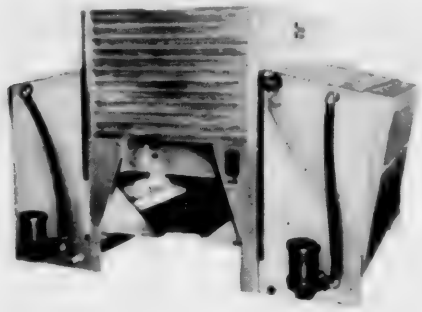
Sampler is designed for hard usage. It is intended primarily for survey work where it will be used for an 8-hour working day. It can be used for longer periods, however, with some reduction in life of the motor windings.

For emergency jobs, the sampler can be slipped into a suit case and taken on a plane.

More information? Circle Item 89, postcard, last page.

Refrigerant Condensing System

Equipment for uniformly controlling condensing temperatures and pressures under all dry bulb conditions is announced by The Marley Co., Kansas City, Mo. The system consists of the basic air cooled condensing unit (marketed under the trade name Dri-Cooler), a pressure controlled damper system for low dry bulb operation, and an air precooler that lowers



high dry bulb entering air temperature. The Dri-Cooler condenser is also available without the auxiliary equipment.

The most recent addition to the system is the company's ADB precooler—dual spray units which adiabatically reduce dry bulb temperature of air entering the condensing unit, giving it greater heat transfer capability without water reaching the coils. Automatic controls actuate the precooler when the ambient dry bulb temperature reaches a predetermined level. The precooler is said to make application of air cooled condensing practical in areas with extremely high peak temperatures by permitting selection of condenser based on lower design dry bulb temperature.

The condensing unit, with its damper control, has recently undergone extensive redesign in outward appearance and condensing capacity. Total height of the units has been reduced approximately 25% and exterior appearance has been architecturally treated by applying embossed corrugated aluminum casing. The number of models in the line has been tripled, providing an economical selection for any application.

More information? Circle Item 90, postcard, last page.

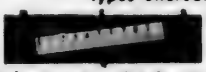
(Continued on page 130)

√Take your choice!

AIR FILTER

Ellison Air Filter Gages are high precision instruments —not dime store gadgets. Built for a lifetime of dependable service. Widely used in public buildings, hotel, hospital and office buildings. Three types offered:

Inclined Tube Type



Accurately indicates air flow resistance in duct at air filter. Easy-read white enamel scale. Level and tube replaceable on the job. Easily installed.

Diafram Actuated, Dial Type

High powered, free floating diafram. Accurate pointer mechanism floats on knift-edge bearings. Easy to read—readily installed.

Bell Actuated, Dial Type

Bell submersed in oil pan actuates the accurate mechanism which floats on knife-edge bearings. Bell oil easily replenished through inlet at top.

● *Ask for Air Filter Gage Bulletin 214.*

ELLISON DRAFT GAGE CO., INC.

542 W. MONROE ST. Since 1896 CHICAGO 6, ILL.

The Ellison Line Also Includes:

Draft Gages, Bell and Diafram—Inclined Draft Gages—Portable Inclined Vertical Tube Gages—Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube-Saturator Gages—U Gages—Stationary and Portable—Air Filter Gages—Dial and Inclined Tube Types—Pitot Tubes—U Path Steam Calorimeters—Portable Gas Analyzers-Orsat Type

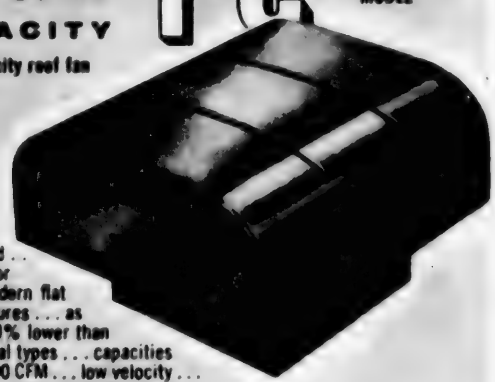
DAVIDSON

LOW PROFILE

HIGH PC CAPACITY

PLEASING CONTOUR MODEL

low velocity roof fan



New and streamlined . . designed for today's modern flat roof structures . . . as much as 40% lower than conventional types . . . capacities up to 50,000 CFM . . . low velocity . . . vibration isolated . . . ratings conform to Standard Test Code.

DAVIDSON, first in the field, has been making a complete line of industrial and commercial roof fans since 1915. For information on the PC or other HYDUTY Davidson fans, write to

Charter Member AMCA

DAVIDSON FAN CO.

213 California St., Newton 58, Mass.

HYDROSTATIC SHOCK

IS JUST LIKE

CLOSING FAUCETS WITH A HAMMER

100 TIMES A DAY!

SMITH HYDRO-Trol

HYDROSTATIC SHOCK CONTROL

CONTROLS SHOCK

PROTECTS YOUR PLUMBING AGAINST THE DESTRUCTIVE HAMMERING PRESSURES OF HYDROSTATIC SHOCK

Every time you quickly close a faucet you might just as well hit it with a hammer, . . . for the fast closing of any valve or faucet produces a hydrostatic shock which strikes a hammering blow to the vital moving parts of the faucet and other parts of the plumbing system. These destructive hammer like forces of hydrostatic shock will make even the best valves and faucets soon wear out if left unchecked.

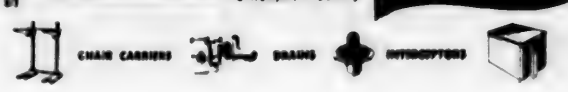
In todays home with modern plumbing appliances utilizing extremely fast closing automatic valves, the frequency with which destructive shock occurs is such that a Shock Control by Hydro-Trol should be installed on every hot and cold water line.

FOR FURTHER INFORMATION, WRITE FOR YOUR COPY OF "SHOCK CONTROL BY HYDRO-TROL"

JAY R. SMITH MFG. CO.

Union, New Jersey

PLUMB-EASY



WATSCO spun-copper
MAGNI-CHEK
VALVE
used to perfection
by
PERFECTION
for heat pumps

AS USED IN PERFECTION'S HEAT PUMP UNIT

U.S. Pat. No. 2,646,071

Recognized for its dependability, Magni-Chek is used by Perfection Industries, and other major manufacturers in the industry. (Names available upon request)

The only true hermetically sealed check valve. Magni-Chek is a non-electric magnetically operated check valve, so finely calibrated that a fraction of an ounce of pressure will open the passage permitting a smooth flow without the usual pressure drop. Since no springs are used, back pressure is at a minimum. A lifetime Alnico magnet controls a floating disc which is drawn to a positive closed position against a lapped seat, when the pressure balances. Available with or without a built-in monel mesh strainer, Magni-Chek is stocked in all sizes ranging from 1/4" to 3/4". Special size inlet and outlet connections can be made to specifications.

Magni-Chek is designed for permanent installation with soft or hard solder, and is not affected by soldering heat. Its one piece construction makes it desirable for use in hermetically sealed units.

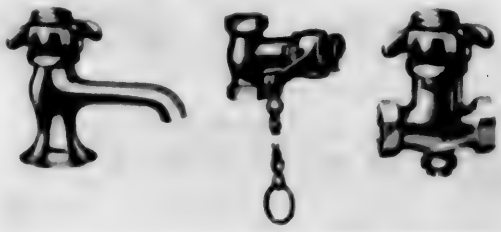
For additional information see your wholesaler or write us, Dept. V-7

WATSCO INC
1020 [illegible] STREET [illegible]

(Continued from page 128)

Improved Self-Closing Faucets

Finger-tip control and positive, quick-acting shut-off result in greater water savings with its improved, self-closing faucets and valves, states the manufacturer, The Royal Brass Mfg. Co., Cleveland, Ohio. Heavy-duty, encased ball bearings are featured.



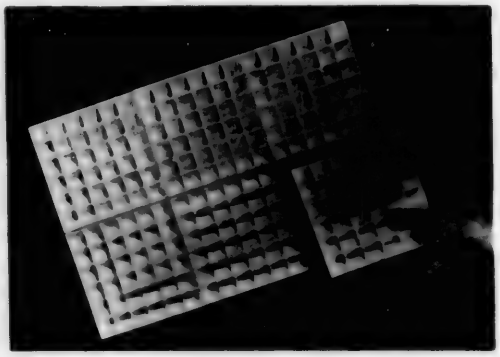
Included in the line are lavatory faucets with elevated spouts (left in photo), sink faucets with male or solid female flanges, pantry faucets with gooseneck spouts, instant-acting shower valves (center) with simple pull-chain and positive shut-off for schools or first-aid applications, and drinking fountain valves (right) with or without volume control.

Meeting Federal Specifications for Type 12 faucets, and military specifications for Type 2 Class A and Type 1 Class C faucets, all working parts are made of brass or bronze with the main body being a heavyweight high-copper brass casting.

More information? Circle Item 91, postcard, last page.

Modular Plastic Diffuser

Carnes Corp., Verona, Wis., announces its new modular plastic diffuser. Combinations of three types of modules provide an infinite number of air patterns and sizes, and snap easily and securely into heavy-



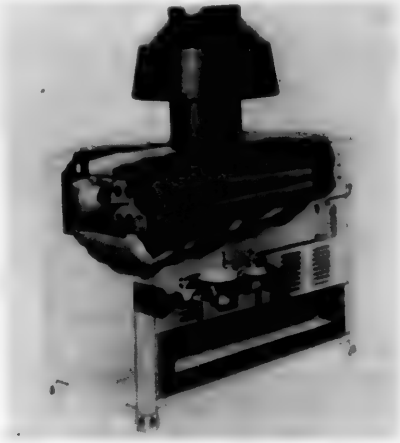
gage frames. Modules are made of high impact and flame retardant material, with color persistency and dimensional stability.

Diffusers are designed for any type of ceiling construction—new or existing—and are especially adaptable to tile and metal pan suspension systems. Basic diffuser faces are sized to replace one or more standard tiles, and are provided with frame modifications and panel assemblies dimensioned for exposed suspension.

More information? Circle Item 92, postcard, last page.

Boiler Has Non-Ferrous Waterways

Series II high efficiency commercial size boilers, announced by Raypak Co., El Monte, Calif., have three one-inch copper fin-tubes, in an "over-back, over-back" pattern, handling the water at high velocity. In addition, completely non-ferrous waterways in the heat exchanger are featured.



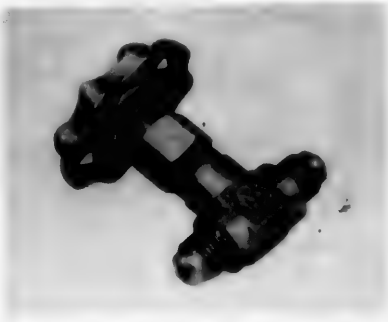
Tube sheet is completely copper lined. A heavy bronze header, instead of the usual cast iron part, completes the non-ferrous design.

Boilers are ASME constructed, operate at 160 psi, and have Btu per hr inputs from 800,000 to 2,500,000. They sell for approximately the same price as steel tube boilers, the company states. Installation of parallel gas modulation valves and staging affords gas modulation down to 5% of total input.

More information? Circle Item 93, postcard, last page.

General Purpose Valves

A new line of general purpose valves for industry is introduced by Madden Brass Products Co., Aurora, Ill. Designed for charging, purging and many other industrial



uses, these valves also meet the increasing demand for panel mounting.

According to the company, outstanding features include forged brass bodies, easy-to-grip handles, and Teflon packing and seats for positive, leakproof shut-off without stress or strain.

More information? Circle Item 94, postcard, last page.

Alnor PYROMETER

Registers temperatures accurately and instantly by simply touching the Pyrometer tip to any surface, or will register air temperatures at grilles, inside ducts etc. with the air temperature thermocouple tip.

Save time with quick positive readings, avoid trial and error methods, eliminate call backs.

With the Alnor Pyrometer you can—

- Set thermal expansion valve on cooling coils in less than a minute.
- Balance hot water systems right the first time.
- Get accurate readings on the effectiveness of insulation.
- Test temperatures of walls, floor, ceilings.
- Locate hot water pipes in cement floors.
- Use it any place where surface temperature readings are required.

Model 2300B. Has full 6 inch mirrored scale. Temperature range −40°F to 200°F. Complete unit in attractive durable case. Price $195.00.

Just tear out this ad and mail with your letterhead to

Alnor INSTRUMENTS

ILLINOIS TESTING LABORATORIES, Inc.
Room 570, 420 N. LaSalle St., Chicago 10, Ill.

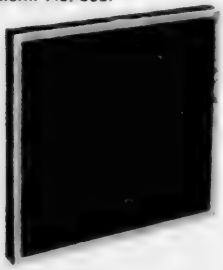
one key doesn't fit all locks . . . nor one FILTER all needs .

OPEN THE DOOR to better filter efficiency with AIRSAN FILTERS engineered to your needs. AIRSAN has the right key to unlock your air filter problems.

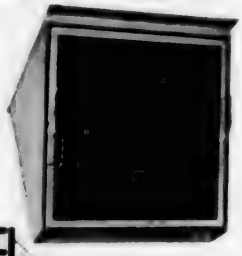
THERE ARE DEFINITE STANDARDS which Air Engineers follow in recommending the filter for your requirements. Write today for details and information.

AIRSAN
Reg. U. S. Pat. Off.
AIR FILTERS

AIR FILTERS (Low Velocity)
Viscous impingement type, permanent and cleanable — designed for industrial, commercial and domestic use. Available in 1" and 2" thickness. Bulletin No. 302.



VIRO-CRIMP (High Velocity)
Has a specially designed high velocity Viro-Crimp filter media. Hemmed edges provide a safety feature. Operates efficiently at 300 to 600 fpm. Available in 2" and 4" thickness. Bulletin No. W-802.



GREASE FILTERS
Permanent, cleanable type Airsan Grease Filters made especially for range canopies, galleys, kitchens. Available in 2" thickness. Bulletin No. L-504.

A few distributorships available. Write for details!

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Air Filter Corporation

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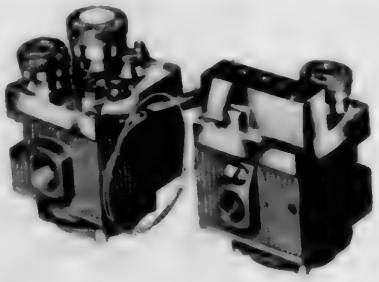
Canadian Representative
DOUGLAS ENGINEERING CO., LTD., TORONTO

Gas Valve for Space Heaters

All control knobs and adjustments are accessibly located on one surface in a new straight-through gas valve, developed especially for space heaters by Heating and Air Conditioning Div., Controls Company of America, Milwaukee, Wis.

The low-cost Model 159 valve comes in two basic types for either electrical or mechanical temperature

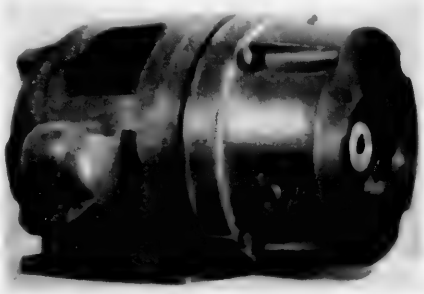


control. An electric actuator allows remote electric thermostat operation in Model 159RE, shown at right in photo. A thermo bulb and an 18- or 36-inch standard length capillary tube provide mechanical thermostatic control in Model 159RMS, shown at left. Optional for each type is a pressure regulator for use with city gas.

More information? Circle Item 95, postcard, last page.

Close-Coupled Pump Motor

Close-coupled hydraulic pump motor, Type H-7, is available from U. S. Electrical Motors Inc., Los Angeles, Calif. Described as rugged, heavy duty, and compact, the motor has a corrosion resistant cast iron frame with a mounting bracket designed to eliminate mounting base, adaptors, and reduce over-all length of pump-motor package. Concentric mounting is assured through the use of the com-



pany's normalized castings that prevent warping of precision machined parts. The cast iron frame also provides the strength and rigidity needed for support of hydraulic pump and motor.

Additional couplings are not needed; a rigid, precision, splined coupling allows direct pump connection. Completely enclosed housing protects against hazard of exposed couplings. Both single- and double-end models are available to fit all standard hydraulic pumps. Ratings are from ¾ to 50 hp.

More information? Circle Item 96, postcard, last page.

Copper Tube Expansion Joint

An expansion joint for copper water tube applications has been added to the solder joint fittings product line of Chase Brass & Copper Co., Waterbury, Conn.

Designed for use with low pressure steam and hot water plumbing and heating lines, and wrought copper,

joint minimizes expansion and contraction noises, relieves pressure from pipings and joints, insulates traveling pipe noises, and protects the system against leaks, breaks, and failures.

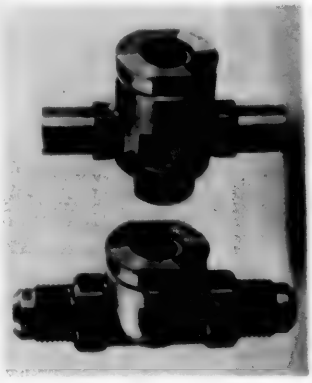
The unit is economical to install and requires no maintenance. Alignment problems are eliminated because of its flexibility and rotatability. The joint compensates for the expansion and contraction movement of 100 lineal feet of copper tube. Sizes range from ½ to 2 inch nominal pipe size.

Designed for operation between 40 and 240 deg F, the joint is factory tested at 150 psi.

More information? Circle Item 97, postcard, last page.

Indicator Assembly Screws Out

A one-piece indicator unit which screws out of the brass body is featured in its new combination moisture indicator and sight glass for refrigeration systems by Ansul Chemical Co., Marinette, Wis.



The "200" Dry-Eye combines a Refrigerant 12 indicator, a Refrigerant 22 element and a sight glass in one interchangeable assembly. The unit screws out of its brass body in one piece to permit worry-free soldering of sweat connections. With the indicator assembly removed, there is no possible way to damage the elements during installation. Once installed, the indicator body is permanently in the line, but the assembly containing the indicating elements can be screwed in or out at any time.

Indicator body is a one-piece brass forging, available in all standard sizes, flare and sweat, in both in-line models (L-200) and T models (T-200).

More information? Circle Item 98, postcard, last page.

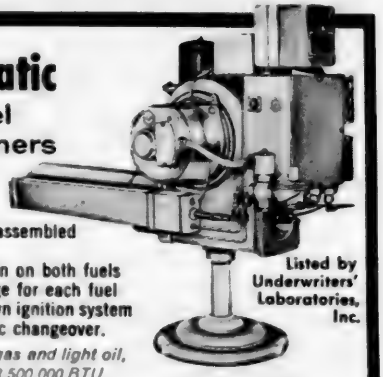
One single source of burners for most every application—that's what Power Flame offers you! In the fact-packed Power Flame Catalogue, you'll discover a complete range of models and sizes in atmospheric burners, power burners and combination burners. All designed for lowest installation and maintenance costs... all "torture tested" for highest efficiency and dependability. Hot idea: Next time, consult Power Flame *first!*

Combi-matic
Dual Fuel
Gas-Oil Burners

With these outstanding features:

- Completely factory assembled and wired
- Balanced combustion on both fuels
- Automatic air change for each fuel
- Each fuel has its own ignition system
- Manual or automatic changeover.

FGO *Six models for gas and light oil, in capacities to 3,500,000 BTU.*



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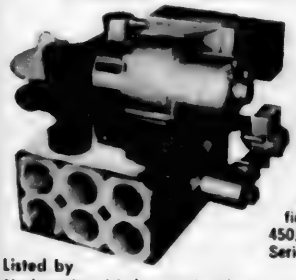

Combi-matic®
Dual Fuel
Gas-Gas
Burners

BFGG—For all gasses and Liquefied Petroleum. A complete line from 450,000 to 20,000,000 BTU. The BFGG Series incorporates many of the product features of the famous FGO Series.

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Write today for complete literature, information and specifications on POWER-FLAME'S Combi-Matic dual fuel burners. Also get the facts about THORO-MIX gas burners and POWER-FLAME gun type and spread type burners.

Power Flame®
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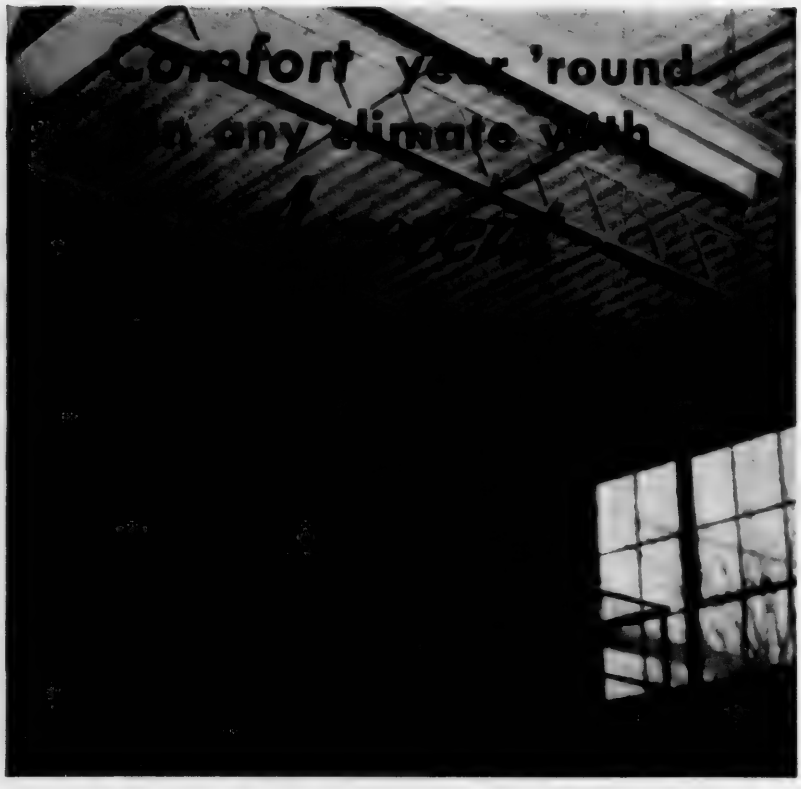
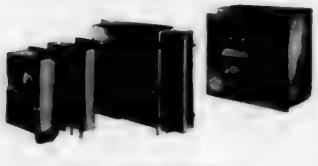


Your best investment in modern air-handling equipment! New Aerovent Air Make-Up Units provide clean, fresh air in winter or summer; help maintain uniform temperature levels throughout working areas. Used as filtered-air supply units or air preheaters, these versatile units permit heating and ventilating systems to operate at design efficiency; equalize negative pressures by replacing exhaust air.

Steam, hot water or gas-fired models in sizes 18" to 54" (larger units available on order) for capacities, pressure conditions and BTU ratings to suit your requirements. Compact, packaged design for roof or wall mounting. Other assemblies also supplied for exclusive use in air supply or air heater applications. Why not investigate the many advantages of these high-efficiency units, today?



STEAM OR HOT WATER

Furnished in 7 unit arrangements in sizes 24" to 54". Capacities from 5,000 to 35,000 CFM. Roof or wall types for all requirements.

GAS-FIRED

Supplied in 4 unit arrangements for roof or wall mounting. Sizes 36" to 54" for various capacities, BTU ratings and pressure conditions.

Write for new Bulletin 880

Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance

CERTIFIED PERFORMANCE

Aerovent FAN COMPANY, INC.

Ash and Brandt Streets — Piqua, Ohio

(Continued from page 16)

COMPRESSOR BODY SHIPMENTS RISE

Manufacturers' shipments of compressor bodies reported to Air-Conditioning and Refrigeration Institute, Washington, D.C., totaled 4,926,657 units in 1959, a gain of almost 37% over 1958 shipments of 3,597,075 units. The figures do not include compressor bodies for use in household refrigerators.

Bodies for automotive air conditioning compressors for the year totaled 527,973 units, compared with 445,487 in 1958, ARI said.

Of the total shipments, 89.2% were sold by their manufacturers as compressor bodies, compressors, or condensing units, and only 10.8% in unitary end-use products. Shipments to other manufacturers accounted for 83.7% of all shipments, with 16.3% moving as a result of sales to non-manufacturers, distributors, jobbers, dealers, and retail customers.

45th ANNUAL I-B-R MEETING ELECTS D. J. QUINN CHAIRMAN

One hundred fifty executives from 68 companies who produce boilers, radiation and other equipment used in hydronic heating and cooling systems attended the three-day 45th Annual Meeting of the Institute of Boiler and Radiator Manufacturers at the Seaview Country Club, Absecon, N.J., June 7 to 9.

Officers elected to serve during the next year were: Chairman, D. J. Quinn, vice-president, Plumbing and Heating Div., American Radiator and Standard Sanitary Corporation; Vice-Chairman, J. E. Reed, president, Sterling Radiator Company, Inc.; and Treasurer and General Manager, R. E. Ferry.

Mr. Ferry reported that shipments of cast iron heating boilers in the first quarter of 1960 showed an increase of 15% over the first quarter of 1959 and 30% over the first quarter of 1958. He stated also that during the past year the membership in the Institute had increased from 57 companies to 68.

Program for the coming year includes a continuation of I-B-R

schools to be held throughout the country for the benefit of hydronic contractors and wholesalers. Nearly 14,000 students have attended these schools during the last 10 years. Other projects will include new I-B-R publications, continuation of the research investigations in the I-B-R Hydronic Research House at Urbana, Illinois, and continued operation of the Institute's Laboratory for determining accurate outputs of radiation.

TOTAL ELECTRIC HOME COMPLETED

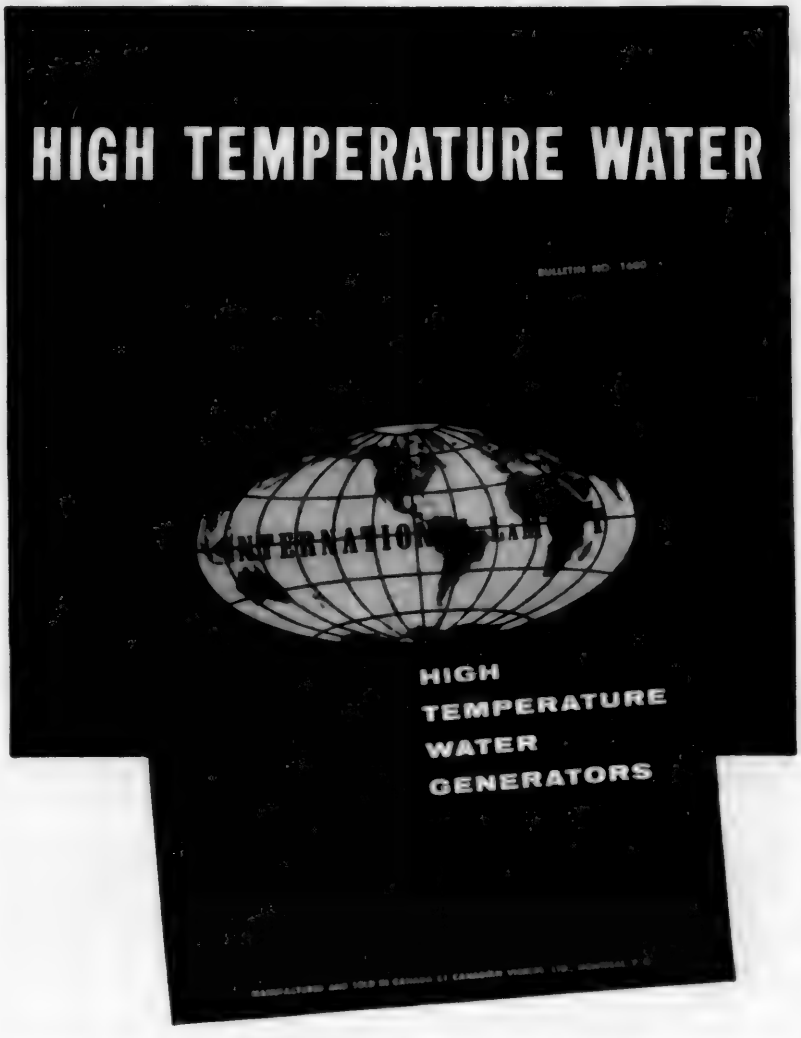
One of the nation's first custom-designed Total Electric Gold Medallion Homes has been completed in Jackson, Miss. This home is one of sixteen being erected throughout the U.S. this spring as part of a program initiated by Westinghouse Electric Corp. and co-sponsored by utilities such as Mississippi Power and Light Co. These are being built as model homes to show that any kind of home can be totally electric.

The Jackson home, designed by architect George Matsumoto, Raleigh, N. C., has a controlled environment on a year-round basis through use of a Westinghouse heat pump. Weather "controls" comprise wide, low-roof overhangs which shield window areas and entries from sun and rain. Operating shutters, an old Southern custom, can close out the hot sunlight. The home was built by J. C. Gibson, of Jackson; Tom Biggs, of Biggs, Weir and Chandler, was the local coordinating architect.

ALL-ELECTRIC APARTMENTS RISING IN PHILADELPHIA

Plans were announced today for the construction of a 13-story apartment house in Philadelphia which, when completed, is expected to be the largest all-electric apartment house in the United States.

The 132-unit, 3½ million dollar apartment house will feature all-electric heat, cooling, lighting and appliances. It will be named the "Iroquois" and may be the first multistory all-electric apartment house to be completed in the United



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INTERNATIONAL-LAMONT

Be sure to obtain a copy of this informative, new bulletin on International-LaMont forced recirculation generators for high temperature water, including the latest engineering data.

Send the coupon below or write for your copy of Bulletin 1600 today.

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THE INTERNATIONAL BOILER WORKS CO.

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WHEN YOU PLAN...
TO SAVE COSTS
Factory-trained Cyclotherm engineers will . . . without charge . . . work with you from drafting board to final installation to estimate your steam demands.
TO SAVE TIME
Factory-trained Cyclotherm servicemen are as close as your telephone . . . at any hour of the day, night or week-ends.
TO SAVE SPACE
Cyclotherm Steam Generators range from 15 to 750 hp. . . . from 15 to 200 psi. For industrial and commercial establishments, shipping, institutions.
Select
CYCLOTHERM
STEAM
& HOT WATER
GENERATORS

Planning a new building? Remodeling an existing structure? As much as ⅓ smaller than other packaged units, the Cyclotherm Steam or Hot Water Generator allows more space for storage and production. Needs only a minimum-sized, minimum-cost boiler room. Or your Cyclotherm can be placed in a working area. Its radiant heat loss is at a minimum.

Lighter-weight, it costs less to transport. Simpler in design, it requires less rigging time . . . lower rigging costs.

Yet it delivers a guaranteed 80% efficiency . . . pays for itself in a few years in fuel savings alone . . . cuts maintenance costs up to 50%.

Exclusive, patented Cyclonic Combustion combined with simplicity of boiler design produces maximum heat transfer wringing every degree of heat from each fuel molecule . . . wasting none. Does in 2 passes what other combustion methods accomplish in 4. Cyclotherm's even rate of heat transfer eliminates localized, heat-retarding scale and "hot spots." All these features assure you of long life and maximum performance.

FREE **Discover how Cyclotherm can give you more steam for your dollar. RETURN THIS COUPON TODAY.**

YEARS AHEAD IN STEAM & HOT WATER GENERATION
CYCLOTHERM
STEAM AND HOT WATER GENERATORS

Cyclotherm Division of Crane Co.
Oswego, N.Y.

Clip to Your Letterhead

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56 East First St., Oswego, N. Y.

☐ Please send me your illustrated folder on Cyclotherm Hot Water Generators.

☐ Please send me your illustrated folder on Cyclotherm Steam Generators.

States, according to officials of the General Electric Co., which is supplying the electrical equipment and appliances. No buildings of this type have been reported in other parts of the world, GE officials said.

They added that several other such apartment houses—each with less than 100 units—are reported in the planning stage in this country, but that none are scheduled for the East.

Builder-owner, Leonard Polis, of Trevose, Pa., said groundbreaking for the "Iroquois" is scheduled for July. He said it will take about eighteen months to complete but will probably be ready for occupancy in early 1961.

Architect is Leon Levin, consulting electrical engineer is William A. Lattanze, and the structural engineer is Philocles Anthopoulos, all of Philadelphia. The Iroquois will have one and two bedroom apartments.

Each room will have electric baseboard heating and a built-in air conditioner, with thermostat temperature control. Each apartment will have an electric domestic water heater with thermostat control and an electric range, oven, refrigerator, garbage disposal unit and automatic dishwater.

BETTER COOLING IS SOUGHT FOR USAF ELECTRONIC EQUIPMENT

A broad research program to identify cooling systems that may improve the over-all effectiveness of ground-based Air Force electronic equipment has been initiated at Battelle Memorial Institute, Columbus, Ohio. The one-year study, authorized by the Air Research and Development Command's Rome Air Development Center, will cover well-established refrigeration techniques, as well as experimental ones.

R. J. McCrory, who will direct the program, said that the Battelle team has been given "the broadest possible specifications" and will consider such devices as high-speed centrifugal compressors, Peltier cooling units, and the Stirling and azeotropic cycles. He indicated that

one goal of the program will be to conceive new cooling techniques. Specialists in refrigeration, combustion, thermodynamics, fluid dynamics, heat transfer, physical chemistry, solid-state physics, organic chemistry, and electronics will contribute to the search for improved cooling techniques.

The staff will, where possible, enlist the assistance of manufacturing organizations and other research groups known or believed to be working on advanced cooling techniques.

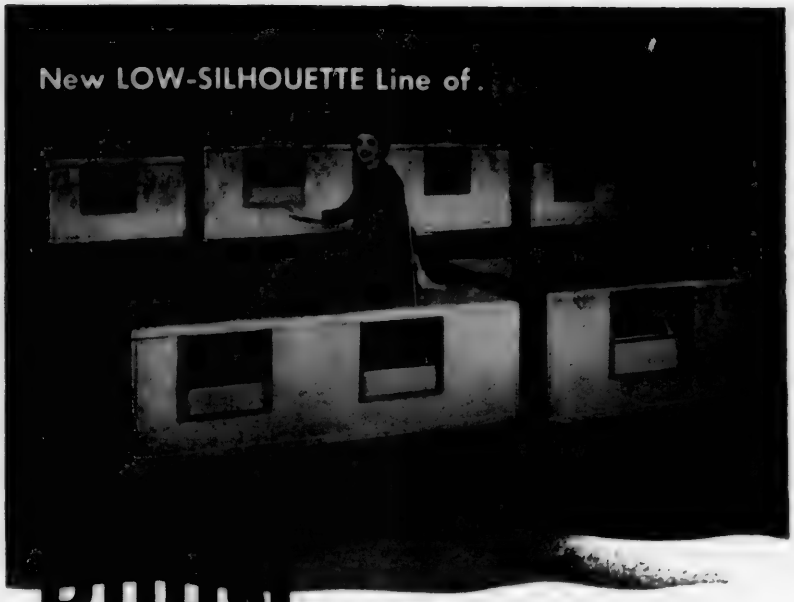
An extensive literature and patent art search has been launched. Cooling systems identified in this state-of-the-art search will be appraised for suitability in developing lighter, smaller, and more efficient refrigeration systems for ground-installed electronic equipment, such as the compact mobile units used to control and track aircraft. In the study, no limitations will be placed on the type of power used in cooling systems. Electric motor drive, integral power sources such as the combustion of fuels, direct use of electricity, as well as waste heat from engine exhaust will be considered.

INDUSTRIAL HEATING MEETINGS

Lennox Industries Inc., Marshalltown, Iowa, is in the midst of a series of engineer meetings in midwest cities. The meetings are designed for consulting engineers, plant engineers, plant managers and others who are interested in the design and application of large capacity space heating equipment.

Up to fifty engineers attend each meeting. They have been planned by Paul Doty, assistant sales manager for Lennox-Marshalltown, and by local Lennox representatives in each city. Main speaker is M. H. Stern, the company's market manager for industrial equipment. Stern's talk is centered about a new industrial heating application manual which he has written.

The cities involved are Denver, Kansas City, Wichita, Milwaukee, Des Moines, Minneapolis, Fargo, Omaha and Rockford.



BOHN YEAR-ROUND AIR CONDITIONING UNITS

In 6 ULTRA-COMPACT Models

Quiet, compact and low in cost, Bohn's new CH line of air conditioning units is engineered to provide maximum efficiency in minimum space for cooling and heating stores, offices, restaurants, apartments and shops. There are six attractive models from 2 through 15 ton capacities. Each features a heavy gauge bonderized steel cabinet with discharge plenum* finished in durable gray hammertone enamel and trimly styled to blend into almost any decor.

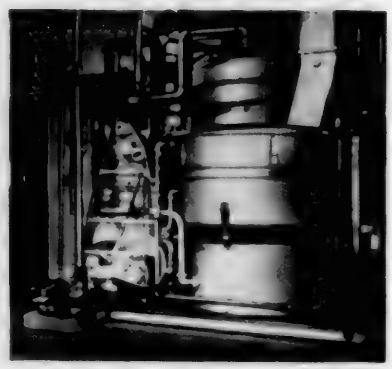
Units can be set up for either cooling or heating, easily converted to year-round air conditioning at a later date... and when desired can be remotely mounted and connected to a duct system. Ease in inspection and maintenance is assured by convenient sectional panel design. Trouble-free operation is provided in standard, open 1725 rpm motors (the drip-proof type with resilient base, adjustable mounting and variable pitch pulley). Write for complete details today.

*Modern discharge plenum with double deflection grille and the fixed inlet grille are both offered as optional accessories.

BOHN Buy the known line... the BOHN line
ALUMINUM & BRASS CORPORATION
Danville Division • Danville, Illinois

3 BOILERS IN 1 COMPACT PACKAGE!

FOR ORDINARY STEAM REQUIREMENTS: The cycle-type Modulätic standard unit furnishes 90% dry steam for most ordinary needs such as cooking, heating water, drying, cleaning, etc.



WHERE DRY STEAM IS REQUIRED: The Modulätic may be used with an optional steam separator, for over 99% dry steam for heating, moulding, forges, operation of power equipment, etc.

VAPOR MODULĀTIC WATER TUBE BOILERS

¼ the size and weight of conventional boilers... largest size (150 BHP) uses only 5' x 8' space.

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NEWS ITEMS

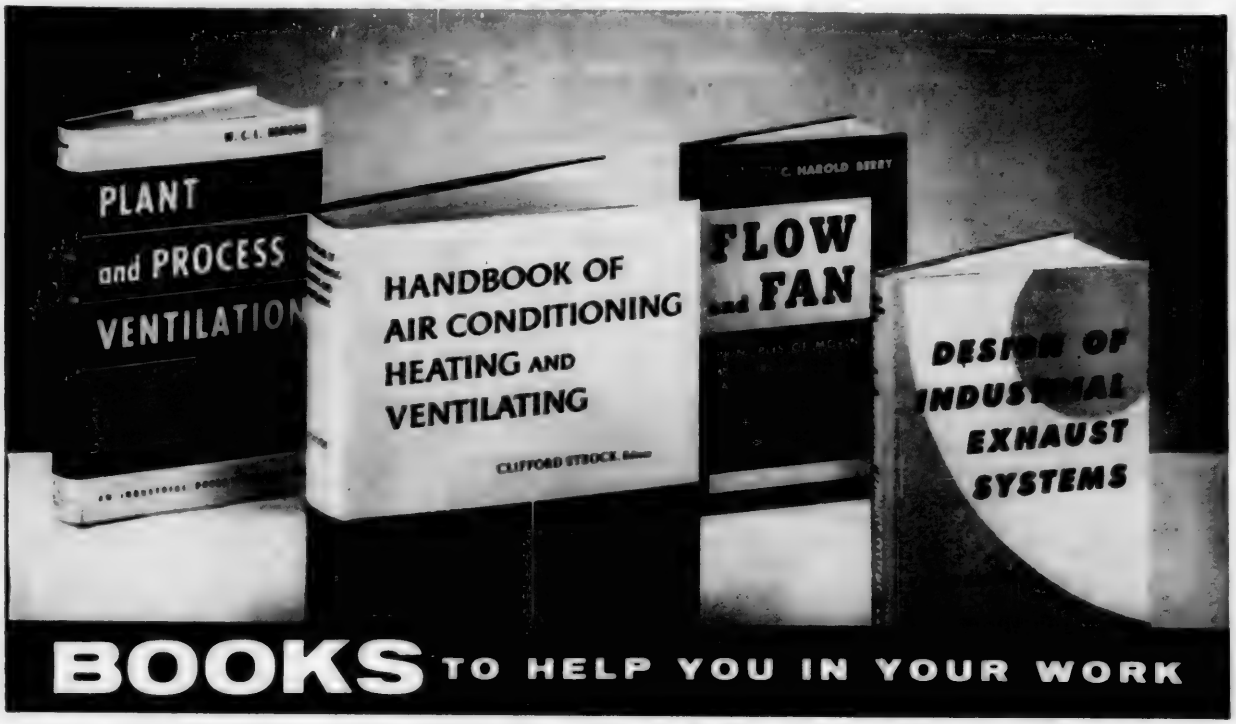
ALBERT KAHN ASSOCIATED ARCHITECTS AND ENGINEERS, INC., Detroit, Mich., have been notified that the new automobile assembly plant, designed for the Chrysler Corporation and built at Fenton, Missouri, near St. Louis, has been named one of the nation's "Top Ten Plants of the Year." The plant was selected from over 500 entries by *Factory* magazine, in its 26th annual *Best Plants* competition. Winners received citations at presentation ceremonies held in New York on May 18.

WITH THE ENGINEERS

Prof. W. T. Miller, who retired last year from the faculty of the School of Mechanical Engineering, Purdue University, was made a fellow in the AMERICAN SOCIETY OF HEATING, AIR CONDITIONING AND REFRIGERATION ENGINEERS at its Annual Meeting in Vancouver, B.C. A member for 30 years, Prof. Miller was active in the formation of the Indiana chapter. The award cites his contribution to the Society and his advanced study programs in heating, air conditioning, and refrigeration. Prof. Miller joined the Purdue staff in 1928 and retired last June. . .

Vito V. Cerami has been appointed senior consultant in the firm of MICHAEL J. KODARAS, Consultants in Acoustics, New York City, N.Y. Mr. Cerami has been actively engaged in the field of mechanical acoustics for the past eleven years as chief engineer and general manager of T. R. Finn & Company, specialists in industrial and military vibration isolation products. As a member of the Kodaras Organization, he will specialize in the acoustical analysis of air conditioning and other mechanical systems. . .

(Continued on page 140)



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PLANT AND PROCESS VENTILATION. By W. C. L. Hemeon. 448 pages, 172 illustrations. The book and its author have contributed original ideas that have led to the modern engineering approach to ventilation design. The book covers fundamentals and properties of all types of air contaminants, a new treatment of dynamics of dust particles and the design of exterior hoods using a new conception enabling designer to estimate exhaust requirements of a cold, multi-directional process by observation. From chapters on estimation of exhaust, heat and general ventilation, the plant engineer can derive a sound, quantitative, independent judgment of factors pertinent to the design. Mr. Hemeon presents a theory for estimating air flow that is induced by the motion of solid particles. He reduces formulas to tabular and graphical form for direct application. Discusses application of behavior of hot contaminated air to design of canopy and exhaust hoods. From exhaust hood rates he leads into new equations to prevent contamination of process due to leakage. He also explains: methods of moving air, natural drafts, roof ventilation, large building air currents and exhaust air cleaning.

Theodore Hatch says, "In style and clarity of presentation, the author has succeeded in expressing some fairly subtle views in terms which will delight the engineer who wishes seriously to master the principles and practices of plant and process ventilation." $9.00

FLOW AND FAN. By C. Harold Berry. 232 pages, 84 illustrations. This basic text on air handling will help you solve your problems of moving air through ducts, selecting and controlling fans, duct arrangement and resistance, system characteristics and flow analysis. The two major divisions of the book cover the flow of gas through duct systems and fan performance and control. It covers the how and why behind basic calculations in the design of systems so that the information is applicable to actual ventilating problems. It presents elementary information and it treats subjects like equivalent orifice and the space-saving Gibson tapered enlargement, which are worthy of study by advanced engineers. You'll find FLOW AND FAN a practical, authoritative, yet interesting and entertaining book. $4.00

HANDBOOK OF AIR CONDITIONING, HEATING AND VENTILATING. Edited by Clifford Strock. 1094 pages, 518 illustrations. A wealth of working data for design engineers in ventilating, heating, air conditioning, piping and plumbing and related fields. 84 pages are devoted to air handling and ventilation and cover such subjects as air flow in ducts, duct friction losses, duct system design, determining required air volume, heat capacity of ducts, testing exhaust ventilating systems, corrosion of fans and ducts, exhaust hoods, weight of metal in rectangular ducts and circular ducts, weight of nonferrous sheets, commercial air cleaners, selector for air cleaners, fan arrangements, fans and blowers, threshold limits of toxic fumes and dust, dust collection. $15.00

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS. By John L. Alden. Third Edition. 256 pages, 137 illustrations. Classic text on designing, building and buying industrial exhaust systems brought up-to-date to meet modern standards of industrial environment. Among the new advances and developments it treats are: fog filters, reverse flow filters, venturi scrubbers and multiple miniature cyclones. The book is the ideal source of information for anyone concerned with the industrial environment. Typical of its practical value are the drawings and detailed specification for hoods serving a wide variety of industrial situations. And it demonstrates the use of data and design principles with an example of how to design a system $6.00

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ACHV—7/60

(Continued from page 138)

Five promotions within the J. O. ROSS DIV., MIDLAND-ROSS CORPORATION, N. Y., were announced. The changes, to become effective within the next few months, will send Robert W. Grott, currently District Manager of the Seattle office, to the New York office as assistant chief engineer for the Division. He is a graduate of MIT, and a sales engineer in the Boston office before being transferred to Seattle in 1956.

Paul Goldner will replace Mr. Grott as district manager of the Seattle office. Mr. Goldner, an experienced paper mill salesman, presently covers the New York State mills from the New York office. He started with the company in 1940 after attending CCNY.

George Schuning, formerly a sales engineer in the Chicago office, will become district manager of the Boston office. . .

ASSOCIATION ITEMS

G. P. Bakken was elected President of the COPPER & BRASS RESEARCH ASSOCIATION, New York, N.Y. as the association of the nation's leading brass mills opened its 38th Annual Meeting at The Homestead, Hot Springs, Va. Mr. Bakken, who is president of Chase Brass & Copper Co., succeeds James M. Kennedy, chairman of the board of Revere Copper and Brass Incorporated. Succeeding Mr. Bakken as senior vice-president of CABRA is E. P. Dunlaevy. Mr. Dunlaevy is executive vice-president of Phelps Dodge Copper Prod. Corp. . .

This year's Distinguished Service Award was presented to William W. Murray, Jr., president of Almirall & Co., New York City. He was cited for his many contributions to the heating, piping and air conditioning industries as well as for his long service to the Association, including a term as National President in 1952-53 and as a National Director from 1946 to 1955.

Operating under its newly revised constitution for the first time, the membership of MECHANICAL CONTRACTORS ASSOCIATION OF AMERICA, INC., automatically elevated to its presidency, its senior vice-president, Joseph S. Kearney. Mr. Kearney is president of the Northwestern Heating & Plumbing Co., Evanston, Ill. The election of officers for the 1960-1961 year was the last action taken at the 71st Annual Convention, held in New York City between May 9th and 12th.

One of the major actions of the convention was the approval of the revision of the By-Laws and Constitution to clarify certain sections and to put into effect a procedure by which national officers progress from the Board of Directors to the newly-named post of senior vice-president, on to the presidency. Until this time, this method of elevation in national office was customary rather than an Association rule.

Other officers elected for the coming year were Frank V. McBride of the Frank A. McBride Co., Paterson, N. J., as senior vice-president, and Leon L. Munier of Wolff & Munier, Inc., New York City, as treasurer. Thomas J. Ryan, formerly executive secretary, was named to the newly-created post of executive vice-president. His duties remain the same. Louis E. Thurber, formerly assistant to the secretary, assumes the title of executive secretary of the Association.

BURGEONING BUSINESS

LEIGH INDUSTRIES, INC., Asheville, N.C., newest subsidiary of AIR CONTROL PRODUCTS, INC., will manufacture the complete Air Control line at its new plant located at the crossroads of principal East-West and North-South highways and on the main line of Southern Railway. Company states that the plant is the largest facility of its kind in the world wholly devoted to production of registers, grilles and diffusers. Warehousing facilities at Birmingham, Ala., have been moved to Asheville. General offices, including sales, advertising, and engineering, will continue to operate out of the parent company's plant in Coopersville, Mich.

THE LAU BLOWER COMPANY, Dayton, Ohio, has purchased assets of Viking Air Products Division of Crane Co., Cleveland, Ohio. Mr. T. I. Byrd, Lau president, said the purchase included tools, dies, jigs, finished and unfinished inventory, and assumption of the lease on Viking's 146,000 sq ft Cleveland plant. The purchase will expand

(Continued on page 142)

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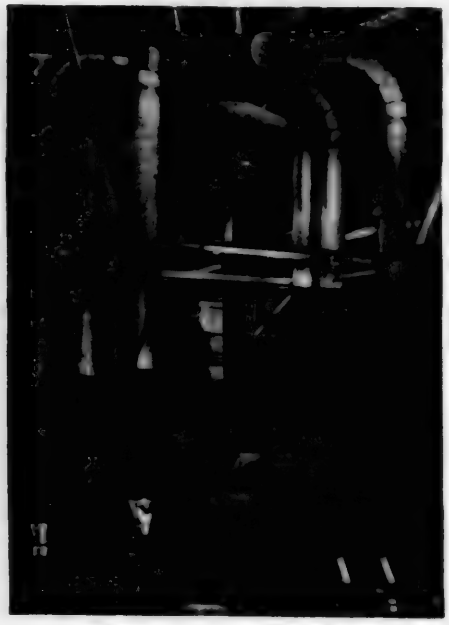

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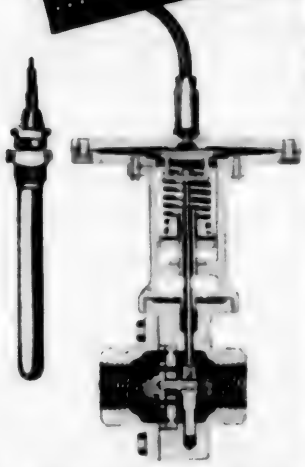

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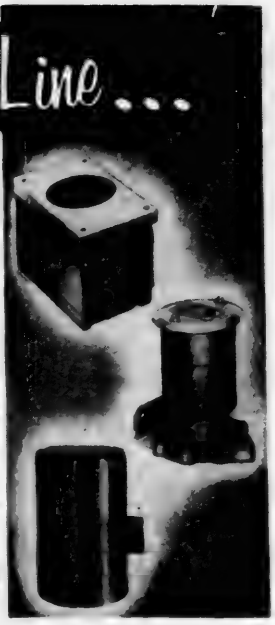

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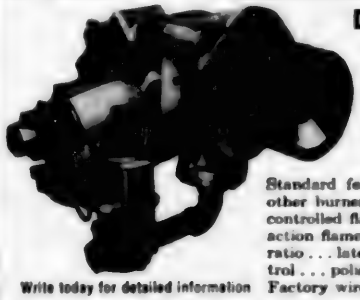

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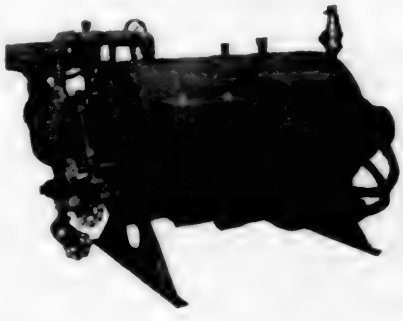

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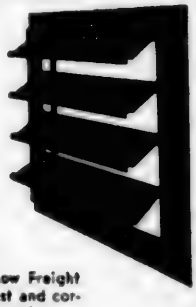

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(Continued from page 140)

product lines, provide additional manufacturing capacity, and increase the sales and distribution organization. The company will now have the products and people to actively solicit heating wholesaler business. . .

CLEAVER-BROOKS COMPANY, Milwaukee, Wis., announced today a major realignment for its New York City sales operation. It is two-fold: First, it is keyed to achieve greater local sales with contractors and direct buyers of packaged boilers in the New York territory. This will be effected through the establishment of new agency, Pennstrom-Martin Associates. Second, a New York national accounts program, responsible for direct selling to national buyers, will be established. . .

TITUS MANUFACTURING CORPORATION, Waterloo, Iowa, will open a branch manufacturing plant in Terrell, Tex. It will be in operation in June of this year and will manufacture extruded aluminum grilles and diffusers for Texas and the entire Southwest market. Manager of the new pant will be R. M. Cagley of Waterloo. The Titus firm has two other plants in operation—the main plant and offices in Waterloo and a branch manufacturing plant in Hialeah, Fla. . .

F. W. DWYER MANUFACTURING CO., instrument manufacturer, primarily concerned with low differential pressure gages and controls, announces the start of construction on its new headquarters and plant in Michigan City, Ind. Increasing demands for the company's products have created a need for enlarged production facilities along with new equipment. Laboratory and engineering facilities have also been expanded to keep pace with its growing research and development program. The new building, scheduled for completion by August 1, is under construction on a 30-acre site located on the northeast edge of the city. . .

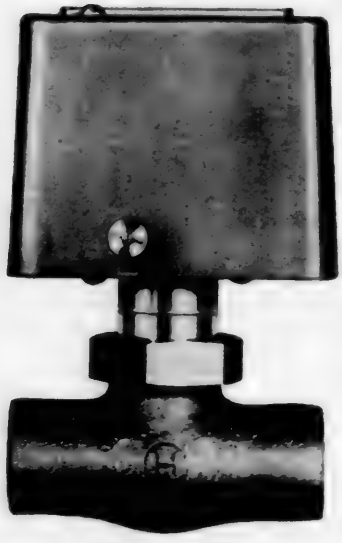
BARBER-COLMAN COMPANY, Rockford, Ill., will expand plant facilities to meet increasing demands for their automatic controls, air distribution products, overhead doors, and industrial instruments. Addition to the Park Plant, situated on fifty acres at the northern edge of Rockford, will increase the present plant area by approximately 170,000 sq ft. General architects for the project are Hubbard and Hyland of Rockford. E. R. Gritschke and Associates of Chicago will design mechanical and electrical installations, including air conditioning, heating, ventilating, plumbing, lighting and wiring.

NEW REPRESENTATIVES

Brice Machinery and Controls Co., Houston, Tex., has been appointed sales representative by ALLIS-CHALMERS, Milwaukee, Wis., for industrial machinery and control equipment manufactured by the firm. Equipment includes electrical and general industrial apparatus, among which are switch gear, transformers, high and low voltage

FOR ZONE HEATING ON STEAM AND HOT WATER

only Zonvalve® has all these important features:



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Raises and lowers valve stem with silent power.

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Gradual opening and closing cycles prevent noise in line.

▶ COMPACT CONSTRUCTION
Compact body makes installation easy, even in tight places.

▶ EASY MANUAL OPERATION
Manual Operator conveniently located on outside of cover, always accessible.

▶ 5-YEAR GUARANTEE
Because of their rugged construction, Zonvalves are guaranteed for 5 years—should last a lifetime!

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motor controls, a-c and d-c integral electric motors, pumps and specialty industrial items. Through this association, BMC offers standard equipment on a competitive basis as well as local shop assembly for coordinated systems. . .

The Chet Adams Company, Greensboro, N. C., has been appointed sales representative in Virginia, and North and South Carolina for GENERAL BLOWER COMPANY, Morton Grove, Ill. General Blower manufactures air and materials-handling fans. The Chet Adams Company, which has offices in Norfolk and Richmond, Va., and in Raleigh and Charlotte, N. C., also is sales representative for Ilg Electric Ventilating Company, of which General Blower Company is a new subsidiary. . .

JAY R. SMITH MANUFACTURING COMPANY, Union, N. J., announced the appointment of Mr. Robert A. Clapper, 1011 7th Street, West, Billings, Mont., as sales representative for the company's line of chair carriers, drains and engineered plumbing products in the state of Montana.

OBITUARIES

Aubry Vaughan Hutchinson, secretary emeritus and formerly executive secretary of American Society of Heating, Refrigerating and Air-Conditioning Engineers from its merger-formed start in 1958 until his retirement in 1959, and similarly allied with precedent American Society of Heating and Air Conditioning Engineers for 36 years, died in Lafayette, Ind., June 6, 1960.

Mr. Hutchinson joined the American Society of Ventilating Engineers (as ASHAE was then termed) in 1922 as manager of publications. He was appointed secretary in 1926 and executive secretary in 1950. When ASHVE became ASHAE, he continued as executive secretary and manager of publications.

He preceded his 37-year career with the Society by entering the publishing field with David Williams Company, New York, in 1914-15. He then served from 1916-17 as assistant and then associate editor of *Metal Worker, Plumber and Steam Fitter* in New York, and as western editor for *Sheet Metal Worker* and *Heating Engineer* in Chicago from 1920 to 1921. . .

R. Fenton Fisher, vice-president (sales) of The Mercoid Corporation, Chicago, Ill., for the past twenty-six years, passed away May 21, 1960 while aboard the S. S. President Wilson returning from Yokohama, Japan. For many years he was in charge of sales for the eastern area and was located in New York City. The past three years his activities were concentrated on the west coast with headquarters in Santa Barbara, Calif. He was well known in the heating field and served on many committees of the Oil Heat Institute of America. He was also a member of the Old Timers Club of The Oil Burner Industry.

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6 SIZES—7 TYPES fit all automatically fired boilers or furnaces . . . burning all grades of fuel oils, gaseous fuels or combination of both. TODD ROTO-PAC is equally efficient when applied to Scotch boilers, firebox boilers, steam and high temperature water generators.

This complete burning system is engineered for extra economy, lowest maintenance costs . . . one self-contained unit including burner, forced draft fan, air-fuel controls, enclosed electric panel, prewired and mounted on base assembly. Also TODD "SAV-PAC" Register Type Burner System.

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WHAT READERS SAY

Psychrometric Properties of Air

EDITOR, AIR CONDITIONING,
HEATING AND VENTILATING:

Will you please refer this to Professor Hedlin, author of the article Applying Weather Data To Greenhouse Cooling, in your April issue.

To begin with, I must concede the inadequacy of your present psychrometric charts to represent a problem dealing with air in the fogged field. This seems to stem from the fact that most air conditioning manufacturers deal with air saturated or partially so.

Figure 3 in the April issue, page 78, does not represent the situation called for in your problem. That is, neither *B* nor *B'* shows air with entrained moisture. Again in Fig. 5, point *D* shows air in entrainment but at a lower dry bulb than point *B* which cannot be for evaporative cooling.

I understand what you're getting at, and I do not mean to quibble, but in recent years there has been an awakening to the possibilities of evaporative cooling and I wouldn't be surprised to see someone "discover" that less air is required to do a job if it is introduced containing entrained moisture and for this reason I want to make a point with you on theoretical psychrometry.

My chart, Fig. 1, shows how I would graphically represent the problem. Line *A-B* shows adiabatic cooling. This cannot be extended with present coordinates because it would show a lowering of the dry bulb, it does go up to a higher dewpoint represented by point *D*. From *D* it picks up room heat to *B'* and then to *C*.

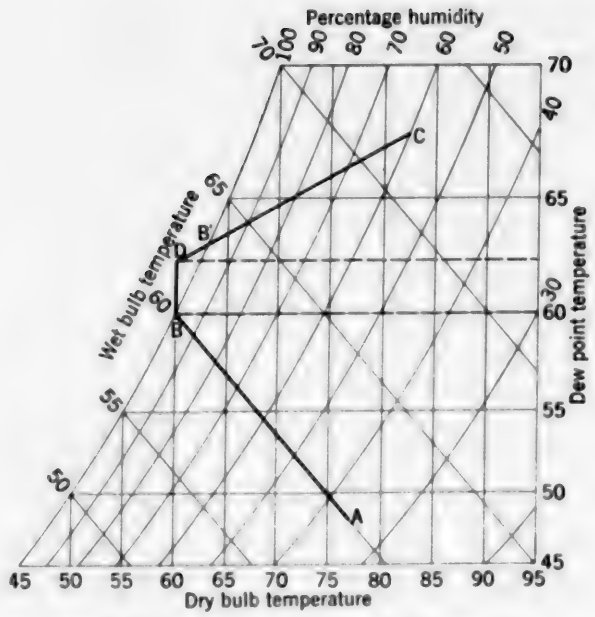
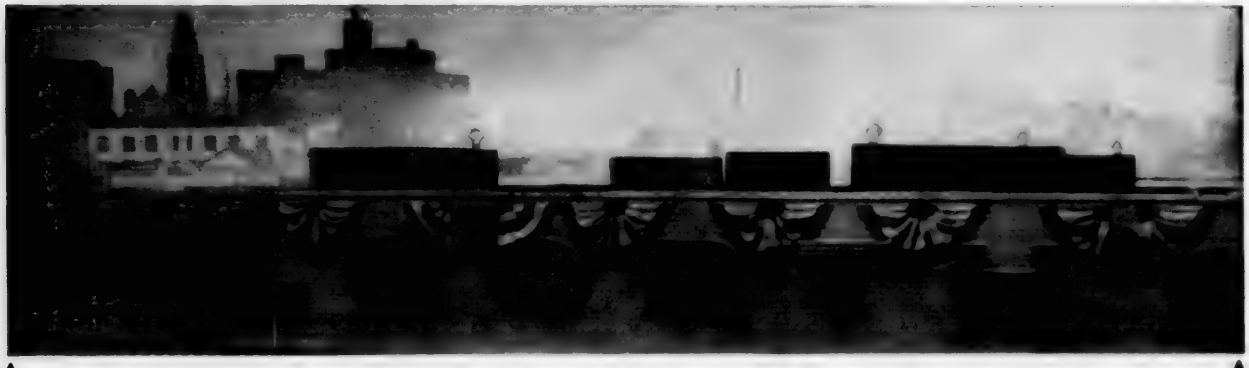


Fig. 1. Graphic representation of problem.

I would be interested in your comments as this has



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Air-Conditioning
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Ventil-Aire's air-conditioning and heating system combines all the elements of built-up systems into one compact package. Air-conditioner, air cooled condensing unit, compressor and gas or oil fired heater are combined in this single operating unit. The unit is delivered ready for installation—requiring cutting small opening through roof, connecting short duct to ceiling diffuser which is supplied and the hook-up of electrical and fuel lines.

The system saves valuable floor space, money in initial cost, installation and maintenance, and delivers more cooling or heating per dollar of operation. Here is air-conditioning and heating at its best for small and large installations. Available in 5, 7½, 10, and 15 ton sizes.

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been my "bread and butter" for 25 years. For another approach to the problem I offer for your consideration an article in the February, 1952 issue of HEATING AND VENTILATING.

James Marshall
Consulting Engineer

Elkins Park, Pa.

Prof. Hedlin has made the following comments in reference to the letter by Mr. Marshall regarding the article on Applying Weather Data to Greenhouse Cooling, as follows:

EDITOR, AIR CONDITIONING,
HEATING AND VENTILATING:

Mr. Marshall's comments raise a number of interesting points in regard to the psychrometric properties of air with entrained water droplets.

In regard to Fig. 3, *A B B' C* is intended only to show the change in the condition of the air-water vapor mixture during the process. Despite the presence of the liquid water in the form of entrained droplets, during the segment *B—B'*, the sensible properties of the air which are normally used to assess air condition, such as dry bulb, wet bulb and dew point temperatures, and vapor pressure, are properly indicated here.

In Fig. 5, the point *D* is reached by adding water at the wet bulb temperature of the air, above the amount which the air can evaporate. This point is not meaningful in terms of most ordinary hygrometers, since they cannot assess the liquid water content of the air. However, it does correctly show the total amount of water, liquid plus vapor, associated with each pound of dry air, and the enthalpy of this mixture. Therefore, for this idealized process, it gives a state point corresponding to the condition of the air emerging from the sprays, which is valid for the solution of this problem.

The point *D* as shown by Mr. Marshall, correctly indicates the measurable dry bulb temperature but, I believe, it would not give the correct enthalpy for the process that I have outlined.

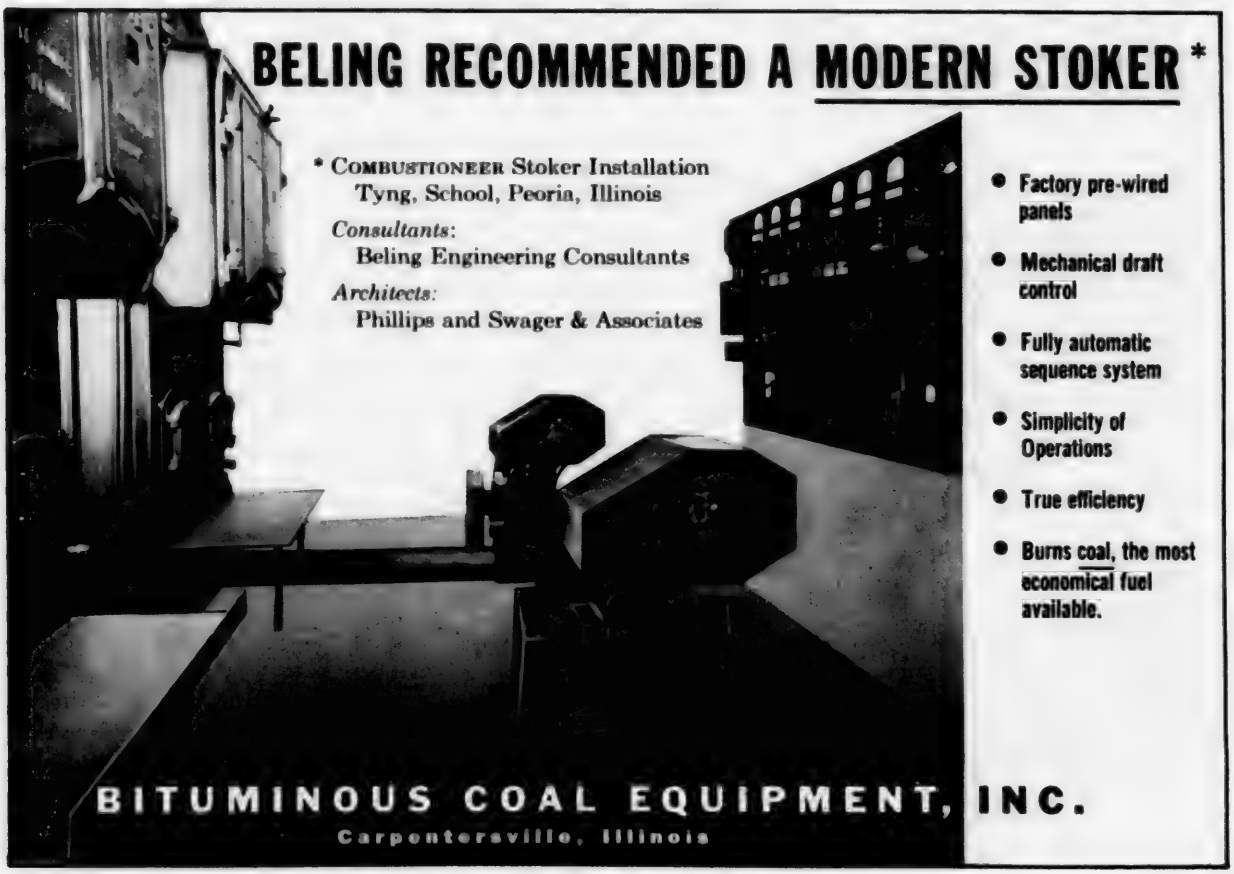
C. P. Hedlin,
Research Officer,
National Research Council

Saskatoon, Canada

All-Weather Comfort Standard

EDITOR, AIR CONDITIONING,
HEATING AND VENTILATING

The referenced article concerning Mr. Emler's speech and the standards which he recommends ("All-Weather Comfort Standard," ACHV, May, 1960) have been read with great interest by many members of the heating and air conditioning industry. There can be no doubt about the need for improved building standards if comfort conditions are to be maintained in the resi-



dential field, but these standards should not be identified with any particular source of heat energy.

The conference at which this standard was proposed dealt with the methods by which the electric industry proposes to capture the residential heating load. This load has become attractive to the electric utilities in recent years because of its tremendous surplus generating capacity in non air conditioning months. As the summer air conditioning peak increases and the load factor drops, individual electric utilities are faced with the necessity for developing increased winter consumption if they are to maintain their basic rate structures. Electric space heating is the perfect complement to the electric air conditioning load for the purpose of load factor improvement.

In attempting to enter the heating market, the electric industry has developed a series of "rules" for the application of electric heat which defy many of the conventional "good practices" of the heating industry.

No provision is made to introduce fresh air into the heated area. This promotes odor-buildup within the structure as a result of cooking, smoking and normal human occupancy. Complete insulation, weather stripping, and the lack of provisions for fresh air combine to produce the feeling that the occupant is living in a stagnant thermos bottle. Every possible effort is made to minimize the calculated amount of outside air heating load developed by infiltration. This leads to insufficient capacity under actual load conditions.

Electric industry attempts to promote the use of spot heating are contrary to the concept of comfort producing "whole house heating." The primary reason for this spot heating approach is to minimize operating costs rather than to promote improved comfort. This approach conflicts with the electric industry's contention that the cost of heating electrically is "reasonable." No safety factor or allowance for pickup can be permitted because of the excessive operating cost.

As illustrated by "Table A" on page 59, electric heat proponents often produce data which results in unfair comparisons between electric heating and combustion type heating. In this table, the ceiling construction recommended for gas or oil heated structures permits 40% greater heat loss than that recommended for an electrically heated structure. As indicated above, the source of heat energy has little connection with the standard of comfort produced. The effect of this chart is to promote the comparison of operating costs between dissimilar structures. A similar effort produced the highly controversial NEMA formula for calculating annual operating costs for electrically heated buildings. This method purports to follow the degree-day method of calculation, but it is modified by the use of a "conservative" constant. The effect of this constant is to reduce the total annual calculated heat requirement to 60-70% of that suggested by the degree-day method of calculation.

The referenced article states that the "Standard" has no official sponsor but has been "accepted" by certain trade associations. Acceptance of such a group of

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300 gals.	85 gals.	77-in.	25-Inches	315,000
180 gals.	50 gals.	63-in.	20-Inches	190,000

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recommendations by various interested parties does not assure proper performance of systems installed under these rules. As in the case of the NEMA formula for the calculation of annual KWH usage for electrically heated homes, it seems obvious that the sponsors of this measure hope that it will be endorsed by FHA as a tried-and-true set of data.

EEI and NEMA members are promoting the idea that there is some peculiar and intangible aspect of electric heating which permits the use of less Btu's to do the job when compared with other sources of heat. NEMA formulae, "All Weather Comfort Standards," and other devices used to cloud the issue cannot eliminate the need for equal heat emission by any two systems under comparison. The electric industry is attempting to change the rules because it finds that it can't compete under the standards which have evolved through fifty years of good heating development work by the combustion fuel heating industry.

Black magic is no substitute for sound engineering if good system performance is expected. When specifications require equal performance of the systems under consideration, gas will be the obvious fuel choice where it is available.

Frank Wright

Director of Utilization
Southern Union Gas Co.,
Dallas, Texas

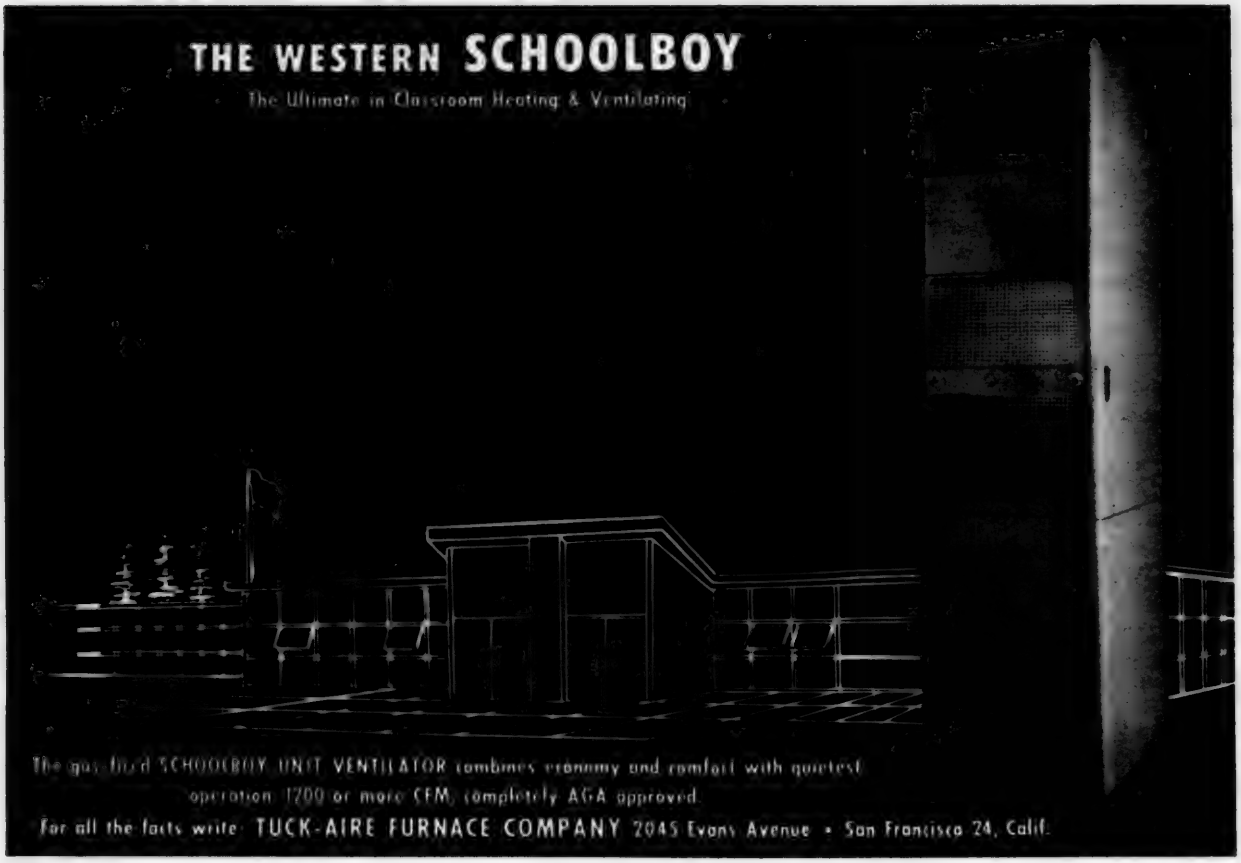
Power Venting of Gas Appliances

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING:

I have read with interest the article entitled "Power Venting of Gas Appliances," by J. P. Jones appearing in *Air Conditioning, Heating and Ventilating*, May, 1960. The power venting of gas flues in some plants is very important as negative pressures within the building may cause backdrafting of gas fired heating equipment which will subject the occupants of the building to possibly dangerous exposures of carbon monoxide. There appears to be a definite need for information on this subject as there has been very little published in the literature.

We have been working on this problem of power venting for a number of years. In most places where makeup air is impractical or uneconomic we have used power venting to prevent backdrafting of the gas fired appliances.

There are several points in the author's discussion which I believe are subject to question. The author states, on page 54, "Several types of exhaust fans can be used, but the two most acceptable are probably the mushroom type wall or roof fan with enclosed motor, and the squirrel-cage scroll housing type with the impeller mounted on the motor shaft." I believe that the author is under the impression that a "mushroom type wall or roof fan" (which is commonly known as the power exhauster), always has centrifugal type blades. These fans can be obtained with propeller type blades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or the centrifugal type. Obviously, the propeller type is unsatisfactory, as it will not deliver enough static pressure without going to a very high rpm which will then produce a noise problem.

The formula the author gives on page 54 for computing the quantity of flue gases is obviously based on the use of a flue gas which has approximate heating value of about 1,000 Btu per a cubic foot. I think it should be pointed out that this formula will not hold for other gases with different Btu ratings used for heating. For example, gases like commercial butane or commercial propane would have two or three times the volume of flue gases as a natural gas of a heating value of about 1,000 Btu per cubic foot.

It is also noted that the author bases the fan capacity against "external static pressure" of 0.375 inches water gage. A more accurate way of doing this is to rate the fan capacity against the static pressure of the piping system, plus the negative pressure in the building. (Which can be measured.) I believe it would be unlikely that an external negative pressure as high as 0.375 inches of water would be encountered in a building. We have checked a great many negative pressures within buildings and find that they very seldom exceed 0.2 inches. At a negative pressure within the building of 0.375 inches of water the pressures required to open an ordinary door would be roughly between 35 and 40 pounds (which would hardly be tolerated by workers). From our experiences we believe that where it is not possible or practical to measure the negative pressure within the building, it would be safe to recommend that the fan have sufficient capacity for overcoming a negative building pressure of 0.25 inches of water plus the static pressure of the ductwork system.

The author states on page 55, "For vent runs exceeding 10 ft. in length and for duct manifolds venting several heaters to one fan, it is recommended that quantities developed, as explained in the problem, be doubled as a safety factor to provide for duct leakage. . . ." Actually on a vent run exceeding 10 feet there would not have double the leakage loss because of the fact that another 10 feet of run have been added. To calculate the system precisely the same quantity of air required to take care of the flue gases is used but new static pressure is calculated because of the greater resistance imposed on the fan by the additional length of ductwork. I think it is important that this be clarified because extra run of ducts will impose more resistance on the fan.

The author recommends on page 55, "In order to conserve the excess pressure capacity of the fan for use against exhaust fans in the area, or to overcome artificial high pressure areas caused by wind effect at the point of discharge, a small single acting barometric draft regulator, should be installed on each appliance vent." It is not clear to me why this is necessary if a draft diverter is installed in the system.

George M. Hama

Senior Associate Industrial Hygienist,
Bureau of Industrial Hygiene
City of Detroit Department of Health

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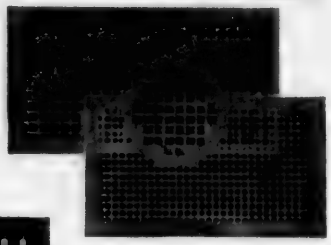

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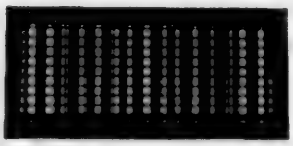

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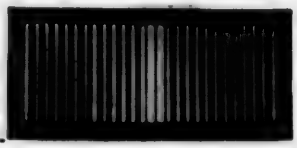

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BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

PLUMBING

Professional Plumbing Illustrated and Plumbing Mathematics Simplified, by Arthur J. Smith, is a new title for the plumbing library. The author is senior plumbing inspector, Santa Clara County, Calif., and chairman, code committee, Western Plumbing officials. His objective in preparing this book was to provide a text book that would be valuable to the plumbing trade teacher or student.

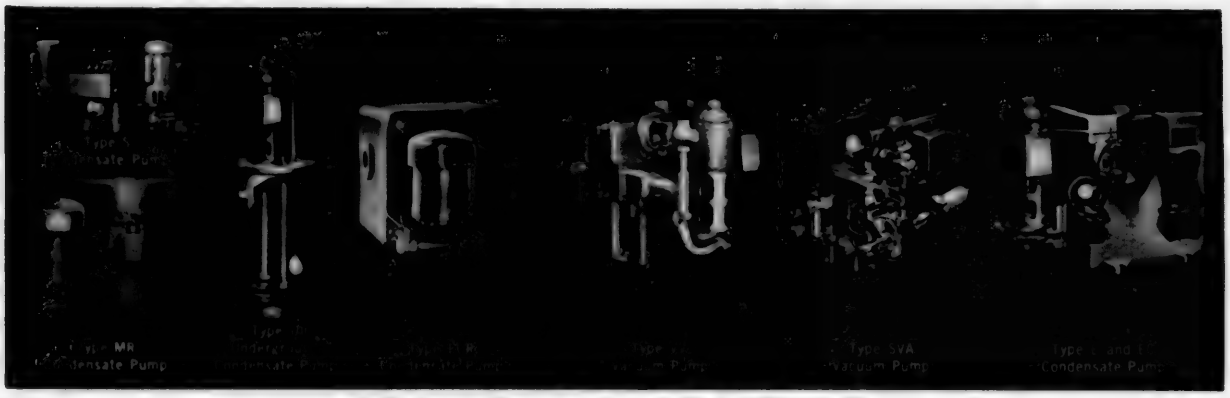
The information presented is concise and there are a large number of illustrations, and tables.

Professional Plumbing Illustrated and Plumbing Mathematics Simplified, by A. J. Smith. Spiral bound, printed by photo offset process, 5½ x 8½ inches, 242 pages. Published by Pro Mark Publications, P.O. Box 150, Santa Clara, Calif. Price, $6.

PIPES, DUCTS AND FITTINGS—A recorded voluntary recommendation of the trade on Pipes, Ducts and Fittings for Warm Air Heating and Air Conditioning Systems (simplified practice recommendation R207-60) has been issued by the U. S. Department of Commerce. The scope is a standard of practice in production, distribution, and use, and the kinds and sizes of prefabricated pipes to be stocked. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 15 cents.

OIL BURNING FOR RESIDENTIAL APPLICATIONS—The Art and Science of Oil Burning for Residential Applications (API Publication No. 1537), 112 pages, has 300 abstracts of technical literature available on the broad field of residential oil burning. The 16 broad subject classifications in the literature review range from fundamental aspects, including the physics and chemistry of fuel oil combustion, to the latest equipment development in the art of oil burning. Compilers of this information hope that it will help researchers and designers to improve residential oil burning equipment. For a copy write to American Petroleum Institute, 1271 Avenue of the Americas, New York 20, N. Y.

Gas Appliance Installation and Piping—The third edition of the American Standard, Installation of Gas Appliances and Gas Piping (ASA Z21.30-1959) has been issued by the American Gas Association. The text, which was prepared by an AGA Committee, has been adopted by the National Fire Protection Association and the National Board of Fire Underwriters. Complying with the information in this 153-page booklet will assure safe and satisfactory utilization of gas. The standards were prepared to specify results rather than to outline in detail how such results shall be obtained. American Gas Association, 420 Lexington Ave., New York 17, N. Y.



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Fan Capacity

The May, 1960 issue of AIR CONDITIONING, HEATING AND VENTILATING has an article on Power Venting of Gas Appliances. On page 54, the formula for fan capacity for a gas unit heater should read:

$$Q = \frac{C \times 1.2\ A \times D \times TC}{60}$$

Where:

Q = cfm fan capacity for standard conditions against 0.375 inch water column external static pressure.

C = cu ft per hour gas input.

A = Air required for combustion of 1 cu ft of gas. This equals 10 cu ft of air for each 1000 Btu of heat content of 1 cu ft of gas. Also 1.2 applies when 20% air is used with other percentages of excess air.

D = Dilution factor. A value of 2 is reasonable when there is a draft hood. Otherwise use values of 1.25 to 1.5.

TC = Factor for correcting vent gas volume to the temperature condition existing at the inlet of fan. The normal factor can be taken as 1.25.

The captions for Figs. 3 and 4 should be:

Fig. 3. Power vent, and wiring diagram, for a gas water heater. The letters indicate *A*, vent fan; *B*, draft sensing diaphragm switch; *C*, gas pressure sensing diaphragm switch; *D*, solenoid gas valve.

Fig. 4. Power vent, and wiring diagram for a gas boiler with a power burner.

Canadian Degree-Days for May, 1960*

City	May 1960	May Normal	Cumulative 1959-60	Cumulative Normal
Calgary, Alta.	537	460	9189	8970
Charlottetown, P. E. I.	401	560	7642	8330
Crescent Valley, B. C.	490	400	8196	7610
Edmonton, Alta.	474	410	9643	9830
Fort William, Ont.	473	540	9931	10180
Grande Prairie, Alta.	568	460	10090	10390
Halifax, N. S.	415	484	6659	7246
London, Ont.	327	330	7372	7230
Medicine Hat, Alta.	389	320	8749	8450
Moncton, N. B.	350	480	7799	8500
Montreal, P. Q.	140	270	7854	8240
North Bay, Ont.	296	470	9409	9520
Ottawa, Ont.	143	330	8217	8580
Penticton, B. C.	335	260	6483	6270
Prince George, B. C.	592	480	8920	8980
Quebec City, P. Q.	321	430	8909	9240
Regina, Sask.	356	420	10599	10400
St. John, N. B.	369	510	7704	8380
Saskatoon, Sask.	397	420	10649	10610
Timmins, Ont.	433	550	10890	11060
Toronto, Ont.	274	316	6849	6898
Vancouver, B. C.	361	320	5299	5230
Victoria, B. C.	417	350	5202	4870
Windsor, Ont.	258	270	6600	6560
Winnipeg, Man.	314	411	10519	10399

* These data are supplied through the courtesy of the Meteorological Branch, Air Services, Department of Transport, Canada.

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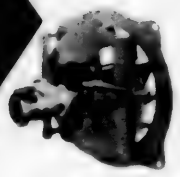

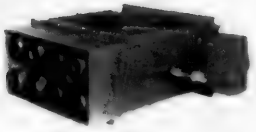

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(Continued on page 153)

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available

CONGRESS ON OCCUPATIONAL HEALTH—13th International Congress on Occupational Health, at the Waldorf-Astoria Hotel, New York City. James W. Muckell, executive secretary, Room 415, 527 Madison Ave., New York 22, N. Y. ..... **JULY 25-29, 1960.**

CRYOGENIC ENGINEERING CONFERENCE—1960 Cryogenic Engineering Conference sponsored by the University of Colorado and the National Bureau of Standards at the University of Colorado, Boulder, Colo. K. D. Timmerhaus, secretary, Chemical Engineering Department of the University, Boulder, Colo. **AUGUST 23-25, 1960.**

CHEMICAL SOCIETY MEETING—138th national meeting of the American Chemical Society, at the Statler Hilton Hotel, New York, N. Y. R. Avery, managing editor of the Society, 2 Park Ave., New York 16, N. Y. ..... **SEPTEMBER 11-16, 1960.**

NACE SHORT COURSE—Short Course on Process Industry Corrosion, co-sponsored by the National Association of Corrosion Engineers Technical Committee on Corrosion Problems in the Process Industries, and Ohio State University, to be held on the University Campus, Columbus, Ohio. T. J. Hull, executive secretary of NACE, 1061 M & M Building, Houston 2, Tex. **SEPTEMBER 12-16, 1960.**

WELDING SOCIETY MEETING—Fall meeting of the American Welding Society, at the Penn-Sheraton Hotel, Pittsburgh, Pa. A. L. Phillips, AWS, 33 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 26-29, 1960.**

ISA EXHIBIT AND MEETING—ISA Instrument-Automation Conference and Exhibit, in conjunction with the 15th annual meeting, at the Coliseum, New York, N. Y. W. H. Kushnick, executive director, Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa. ..... **SEPTEMBER 26-30, 1960.**

CSA MEETING—66th annual meeting of Central Supply Association, at the Palmer House, Chicago. J. H. Peery, secretary of the Association, 221 N. LaSalle St. Chicago 1, Ill. **OCTOBER 5-7, 1960.**

ASSE MEETING—Annual meeting of the American Society of Sanitary Engineering, at the U. S. Grant Hotel, San Diego, Calif. S. Schwartz, secretary of the Society, 228 Standard Building, Cleveland 13, Ohio. ..... **OCTOBER 9-14, 1960.**

AMERICAN INSTITUTE'S CONVENTION—Ninth annual convention of The American Institute of Supply Associations, Inc., to be held at the Americana Hotel, Bal Harbour (Miami Beach), Fla. Geo. T. Underwood, executive secretary of the Institute, 1628 Rhode Island Ave., N.W., Washington 6, D. C. **OCTOBER 23-26, 1960.**

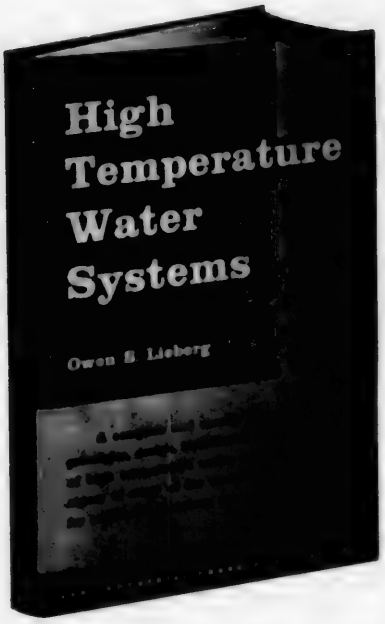
CONSULTING ENGINEERS COUNCIL—Semi-annual meeting of the Board of Directors of Consulting Engineers Council, to be held in Pittsburgh, Pa. Headquarters to be announced later. L. N. Spiller, 326 Reisch Bldg., Springfield, Ill. ..... **NOVEMBER 10, 1960.**

BRI FALL CONFERENCES—Fall Conferences of the Building Research Institute, at the Shoreham Hotel, Washington, D. C. Harold Horowitz, Assistant Director for Technical Programs, BRI, 2101 Constitution Ave., Washington 25, D. C. ..... **NOVEMBER 14-16, 1960.**

ARI ANNUAL MEETING—First annual meeting of the Air-Conditioning and Refrigeration Institute, at the Hollywood Beach Hotel, Hollywood Beach, Fla. Geo. S. Jones, Jr., manager of ARI, 1346 Connecticut Ave., N.W., Washington 6, D. C. ..... **NOVEMBER 18-22, 1960.**

POWER EXPOSITION—24th National Exposition of Power & Mechanical Engineering, sponsored by the American Society of Mechanical Engineers, in conjunction with its annual meeting, to be held at the New York Coliseum, New York City. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. ..... **NOVEMBER 28-DECEMBER 2, 1960.**

NATIONAL SYMPOSIUM ON TEMPERATURE—Third National Symposium on Temperature—Its Measurement and Control in Science and Industry, sponsored jointly by the American Institute of Physics, Instrument Society of America, and the National Bureau of Standards, to be held in Columbus, Ohio. C. L. Roberson, ISA, 313 Sixth Ave., Pittsburgh 22, Pa. ..... **MARCH 27-31, 1961.**



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- Some Design Considerations
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- Boilers and Expansion Tanks
- Controlling the System
- System Circulation Pumps
- Valves
- Piping
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- Space Heating with HTW
- Applications
- Designing a Typical System
- Appendix

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(Continued from page 151)

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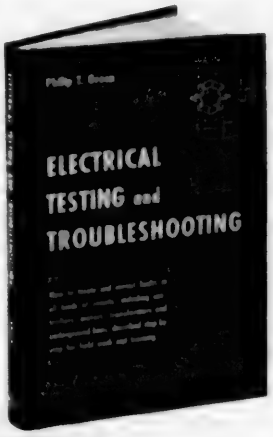

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*Advertiser appeared in preceding issue

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

PRESSURE RELIEF VALVES ..... made by Watts are available in the most complete line in the industry. In particular, No. 740 Series for hot water heating boilers offers a full selection of high capacity valves providing low cost protection. Information on entire line of protection and control specialties offered.
Inside Front Cover — Item 200

UNIT TRAPPING EXPLAINED ..... in Armstrong steam trap ad. Using an individual trap for each steam heated unit, including each separate coil, chest, or chamber of a machine, pays off for the user. Two examples are given. A 44-page Steam Trap Book and reprint of article on unit trapping are offered.
Page 1 — Item 201

HEATING PUMPS ..... made by Skidmore feature mechanical shaft-seal, close-coupled design, giving more capacity and better performance. You can specify Skidmore right down the line, whatever the application, wherever you need a dependable heating pump. Information available.
Page 2 — Item 202

POWER ROOF EXHAUSTER ..... in the Jenn-Air Key Line has the lowest contour of any unit with circular discharge efficiency. It is 40% lower. Motor and drive are out of air stream. Maintenance-free spun aluminum housing. Bulletins on centrifugal and axial units offered.
Page 5 — Item 203

NEW CUBE TYPE AIR FILTER ..... offered by Union Carbide has Dynel filter medium which stops and holds unusually large quantities of dirt. Lasts six times longer. As dirt builds up on inside face, air flow is shunted to large filtering area of four sides. Information available.
Pages 6-7 — Item 204

FLUSH VALVES ..... manufactured by Coyne & Delany are the only completely diaphragm-operated, nationally distributed line available. Durable, longer-lasting chrome tanned leather diaphragms operate best in water service and last for the life of the building. Information on this fast-growing line is available.
Page 9 — Item 205

AIR HANDLING PROBLEMS ..... can be solved by New York Blower products which include centrifugal unit heaters, general purpose fans, industrial fans, roof ventilators, propeller fans and propeller unit heaters. Information is available.
Page 11 — Item 206

PACKAGED AUTOMATIC BOILERS .... made by Orr & Sembower hold pressure steady even when demand jumps. Thus, Powermaster boilers give better, more dependable processing. Bulletin explains.
Page 13 — Item 207

PERFECT FILTER-DRIERS ..... called Catch-Alls were the first to feature molded porous cores, full flow, tamper proof seals, and to be available in replaceable core models and to have cores individually packed in hermetically sealed metal cans. Sporlan bulletin on the See-All single dot combination moisture and liquid indicator, offered.
Page 15 — Item 208

OFFICE BUILDING EQUIPMENT ..... is offered by American-Standard Industrial Division in a new concept of coordinated products and services which offers one-source responsibility for all the year-round air conditioning equipment needed. You plan by the piece and select by the package. Information offered.
Insert 17-20 — Item 209

FIBER GLASS INSULATION ..... made by Pittsburgh Plate Glass has extraordinary sound deadening qualities which eliminate fan noise. Excellent thermal-barrier. Low resistance to air flow. Easy to handle and install, and not affected by humidity. Available in a range of sizes, densities, and facings to meet any insulation specification. Information available.
Page 21 — Item 210

HERMETIC COLD GENERATOR ..... by Trane is a packaged liquid chiller of advanced design for a wide variety of process or comfort applications. All major components built by Trane. Advanced hermetic design for maximum efficiency; minimum maintenance. Passes through 36-inch door. Information available.
Pages 22-23 — Item 211

NEW FORCED DRAFT BURNERS ..... made by Ray Burner Co. cut construction costs, fuel costs, erratic performance, and down time. Available two ways to meet your needs and budget: Burner alone, or completely packaged combustion unit. Three sizes fit any boiler, range from 7 to 30 gph. Information available.
Page 24 — Item 212

NEW COPPER TUBE ..... for air conditioning and refrigeration is now available from American Brass Co. under the Anaconda label — cleaned, dried, capped, color-coded and marked "ACR." Sizes from ⅛ inch through 1⅜ inch OD. Information available.
Page 25 — Item 213

CONTROL OF FAN-COIL UNITS ..... is discussed in two-page advertisement by Barber-Colman Co. Four distinct types are explained. For complete data, "Application Manual Brochure on Control of Fan-Coil Units", is offered.
Pages 26-27 — Item 214

VALVES FOR ALL SERVICES ..... in the new Denver Hilton Hotel were supplied by Jenkins. When you install valves in heating, plumbing, and air conditioning lines you may well remember that this line is preferred by many of the country's top building experts for almost a century, although they cost no more. Information available.
Page 28 — Item 215

QUIET PACKAGES ..... by McQuay are named Seasonvents. These heating and ventilating units have highly efficient sound absorbing plenum sections and internally mounted fan motors, making these units ideal for auditoriums and theaters. Information available.
Page 29 — Item 216

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

SWEAT-PROOF INSULATION ..... called Aerotube by Johns-Manville is a flexible foamed plastic pipe insulation that cuts installation costs in half. Has a built in vapor barrier. Recommended for heating, plumbing and air conditioning service. Brochure available.
Pages 30-31 **Item 217**

GENERAL PURPOSE PUMP ..... manufactured by Taco, if installed today need not be lubricated until 1970. Freedom from lubrication worries is one of many reasons why pump is ideal for use in air conditioning systems and hundreds of other applications. Simplified design. Complete specifications offered.
Page 32 **Item 218**

GLASS FIBER INSULATIONS ..... are fully described in technical brochures offered by Gustin-Bacon. Three are offered: One on Snap-On pipe insulation, one on Ultralite duct wrap and lining, and one on a new prefabricated glass fiber duct. Bulletins contain complete specifications and are kept up to date.
Page 33 **Item 219**

DUAL-DUCT CONDITIONING ..... by Buensod-Stacey is unobstrusive: cooling in summer, warming in winter, and always maintaining proper conditions. But no visible duct or room units. Never a balancing problem, thanks to automatic volume control. Information available.
Page 35 **Item 220**

FIBER GLASS DUCT LINER ..... from Johns-Manville has "dual density" which is described as an entirely new concept in fire resistant and sound absorbent duct linings. Information is available.
Pages 36-37 **Item 221**

CIRCULAR CONDENSERS ..... are produced by Yuba-Aimco Div., specialists in the production of these air cooled units. Called Fandaire, they make a big difference where a graceful silhouette is required for architectural compatibility. Fintube design for high heat dissipation. Weighs less. Sizes from 3 to 120 tons. Information available.
Page 38 **Item 222**

FORCED DRAFT FIRING ..... provided by Iron Fireman eliminates the need for high stack of the type required for natural draft firing. Electrical power consumption reduced. Quieter, more compact, more accessible. Units completely packaged. Details available.
Page 39 **Item 223**

FRAMED CONVECTORS ..... by Modine are the easiest to install and easier on the wall. Called Perma-Lap, the framing assures a neat, permanent recessed insulation enabling units to be serviced without disturbing the wall seal. No wall streaking, cracked plaster, or peeled wall paper. Bulletin and catalog available.
Pages 40-41 **Item 224**

FOUR-WAY REVERSING VALVES ..... made by Alco like a compressor for long, reliable life. No plastics are used. Applicable to all reversed cycle systems. Units have operated under test for 300,000 cycles without failure to shift and without loss of tight seating. Tests were made by independent laboratories. Specifications available.
Page 42 **Item 225**

SELF-CONTAINED UNIT ..... offered by Warren Webster is called a new concept in heating and cooling. Comfort control is at your fingertips—day or night, summer or winter. Information is available.
Page 43 **Item 226**

NEW AIRFOIL BLADED FANS ..... offered by American-Standard Industrial Div. exceed 90% efficiency. All units carry the AMCA certified rating seal. Ideally suited for general ventilation and industrial process applications. Bulletin available.
Page 44 **Item 227**

PACKAGED BOILER ..... offered by Petro has no base or low water line, reducing height as much as 24 inches. No pitting is necessary. Uses exhaust vent only; no stack is needed. Combustion achieved even in cold fire box for outstanding fuel economy. Literature and specifications offered.
Page 45 **Item 228**

PNEUMATIC CONTROL SYSTEMS ..... offered by Johnson are backed by the largest and most experienced service force in the control industry. Full-time, factory-trained service mechanics are stationed in hundreds of cities across the nation. Full details available.
Page 46 **Item 229**

CENTRIFUGAL PUMPS ..... offered by Bell & Gossett are leak-proof in operation because the seals are made of Remite, a new material developed in B & G's research labs. Almost diamond-hard, Remite is corrosion resistant as well as wear-proof. Gives trouble-free service even when the pump liquid contains foreign material. Information available.
Page 47 **Item 230**

QUALITY FLUSH VALVES ..... are offered by Sloan at no extra cost. Their Segment Diaphragm costs a lot more to make, however, which adds a bonus of quality. It is made of natural rubber, vulcanized with brass reinforcements. Flexing action of rubber prolongs life. Information available.
Page 48 **Item 231**

STEAM BOILERS ..... manufactured by Babcock & Wilcox have built-in durability. Whatever your steam requirement, whatever your most economical fuel, the company has the boiler best suited to your application. Full information available.
Page 49 **Item 232**

NEW CARRIER PRODUCTS ..... include a complete line of hermetic condensing units with capacities from 10 to 145 tons; a new 15-ton condenser that can be mounted on roof vertically or horizontally; and new fan and coil Weathermakers which, with a single piping system, will provide individual control of cooling and heating for multi-room buildings. Information available.
Page 50 **Item 233**

COPPER TUBE BOILERS ..... by Bryan Steam provide hot water for pool heating, space heating, and domestic supply in one, multi-purpose water heating system. Separate heat exchangers furnish desired temperatures. Indirect heat-exchanger method minimizes scale formation and corrosion. Information available.
Page 51 **Item 234**

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement. All advertisements are digested here except those that are received too late for inclusion in this listing.

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

ZONE CONTROLLED CABINET .....
offered by Buffalo Forge provides year-round comfort conditioning to suit many different areas of a building. Each zone controlled automatically. Rugged tubular frame is easily assembled and installed. Floor or suspended mounting. Low head room due to 45 degree pitched coils. Bulletin available.
Page 53 Item 235

GALVANIZED SHEETS .....
made by Wheeling Steel and tradenamed Softite can be used wherever steel sheets can. It will not be damaged in snipping, notching, scribing, slitting, shearing, hemming, bending, dovetailing, crimping, or sawing. Information available.
Insert 54-55 Item 236

HEATING SPECIALTIES .....
made by Marsh Instrument Co. consist of uniformly good radiator valves, traps, and vents. Radiator valve and trap illustrated is truly packless, not just called packless. It has no packing whatever. Up to date heating specialties catalog offered.
Page 56 Item 237

CARRIERS AND CLOSET FITTINGS ....
are available from Josam for every type of wall-hung fixture, for residential and commercial installations. Manual offered contains facts showing why these carriers are the most advanced in the field.
Page 57 Item 238

CAST IRON BOILERS .....
made by Weil-McLain can be installed in a penthouse without a derrick. The sections can be brought up in the personnel hoist. Boiler need not be installed before the building is completed. Data on gas and oil boilers available.
Page 58 Item 239

QUIET AIR-COOLED CONDENSERS ...
offered by Halstead & Mitchell have had fan noise, vibration, and rattling engineered out of them. Deep pitch fans are run at slow speeds. Casings are rugged and will not loosen with use. Provision for winter operation and multiple circuiting. Information is available.
Page 59 Item 240

ELECTRIC MOTORS .....
made by Fairbanks, Morse are tailored to actual operating conditions, not standardized to the average. Motors, even in hard-to-fit cases, are rated, dimensioned, and insulated to furnish unfailing power. Insulating materials carefully tested, selected, treated, and prepared to match the job. Capacities from 1 hp to 10,000 hp. Information available.
Insert 125 Item 241

STORAGE WATER HEATER .....
for commercial, industrial and institutional use is offered by Patterson-Kelley. Indirect gas-fired unit boasts many advantages. Catalog is available.
Page 126 Item 242

AIR FILTER GAGES .....
in three types are offered by Ellison Draft Gage Co., Inc. Bulletin describing the high precision instruments is available.
Page 129 Item 243

LOW PROFILE ROOF FAN .....
by Davidson has new and streamlined design for today's modern flat roof structures. As much as 40% lower than conventional types. Capacities to 50,000 cfm. Information available.
Page 129 Item 244

HYDROSTATIC SHOCK CONTROL ....
offered by Jay R. Smith protects plumbing against the destructive hammering pressures of hydrostatic shock. Without such control, each quick closing of a faucet is equivalent to hitting the faucet with a hammer. One of these controls should be installed on each hot and cold water line. Free booklet gives details.
Page 129 Item 245

SPUN-COPPER CHECK VALVE .....
made by Watsco is used in Perfection Industries' heat pump and by other major manufacturers, because it is the only true hermetically sealed check valve. Called Magni-Chek, it is non-electric-magnetically operated, so finely calibrated that a fraction of an ounce will open it. Information offered.
Page 130 Item 246

PYROMETER .....
manufactured by Illinois Testing Laboratories under the Alnor label is the most valuable instrument in the tool kit for the heating and air conditioning contractor. One, with full 6-inch mirrored scale, with temperature range from minus 40 to 200 deg, in durable case, costs under $200. Information available.
Page 131 Item 247

FILTER BULLETINS .....
describe the various Airsan air filters which perform the specific duty for which they are designed: Low velocity filters, high velocity filters and grease filters.
Page 132 Item 248

BURNER CATALOG .....
offered by Power Flame Div., Inc., includes a complete range of models and sizes in atmospheric burners, power burners, and combination burners. All designed for lowest installation and maintenance cost.
Page 133 Item 249

AIR MAKE-UP UNITS .....
by Aerovent provide comfort year-round in any climate. Used as filtered-air supply units or air preheaters, permitting heating and ventilating systems to operate at design efficiency. Steam, hot water, or gas-fired models, in sizes to 54 inches. Bulletin available.
Page 134 Item 250

HIGH TEMPERATURE WATER DATA ...
has been brought up to date and published in Bulletin 1600 by International Boiler Works Co., the most experienced name in HTW generation. Bulletin is entitled "High Temperature Water Generators."
Page 135 Item 251

STEAM, HOT WATER GENERATORS ..
made by Cyclotherm will save on costs, time, and space for new buildings or in remodeling existing structures. As much as one-third smaller than other packaged units. Can be placed in a working area. Illustrated folders available.
Page 136 Item 252

AIR CONDITIONING UNITS .....
are offered by Bohn in six low-silhouette, ultra-compact models. For cooling and heating stores, offices, restaurants, apartments, and shops. Capacities from 2 through 15 tons. Complete details available.
Page 137 Item 253

WATER TUBE BOILERS .....
tradenamed Modulatic by manufacturer, Vapor Heating Corp., are efficient and economical, and are actually three boilers in one compact package. Bulletins are offered.
Page 138 Item 254

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

FLEXIBLE HOSE .....
made by Flexaust of high quality metal and neoprene coated fabrics has proven lower in installation costs and provides exceptional abrasion resistance, noise absorption and easy relocation of hoods and machines. Full details available.
Page 140 Item 255

ELECTRIC STEAM BOILERS .....
are manufactured by P. M. Lattner Mfg. Co. in ten sizes. Of ASME construction, the units have highly sensitive adjusting controls. Information is available.
Page 141 Item 256

CONDENSATE DISPOSAL PUMPS .....
designed for air conditioning and refrigeration are offered in a complete line by March Mfg. Co. Bulletins are offered describing all of them, which are furnished with 110/220 volt motors, are factory tested and ready to run.
Page 141 Item 257

PRESSURE BURNERS .....
for dual-fuel, gas, or oil are offered by Synchronous Flame. Designed for hard-to-fire jobs: all types of boilers, warm air furnaces, and ovens. Many standard features which are extras on other burners. Detailed information offered.
Page 141 Item 258

EXTRUDED ALUMINUM SHUTTERS ....
from Elgo Shutter & Mfg. Co. are of modern design, light weight, fully weather-stripped, easier to install, and are rust and corrosion proof. Complete specifications are available.
Page 141 Item 259

TEMPERATURE CONTROL VALVE .....
with sliding gate seats, offered by OPW-Jordan, is a simply designed, self-operated, automatic unit that will give tight shut-off and accurate control. Features stainless steel, self-cleaning and self-lapping seats which can be reversed for heating or cooling applications, and a field-removable thermal system. No electricity or compressed air needed. Information available.
Page 141 Item 260

FOR ZONE HEATING .....
on steam and hot water systems, only Zonvalve, by Heat-Timer Corp., has 7 important features listed in ad. Brochure is offered.
Page 142 Item 261

PACKAGED ROTARY BURNER .....
offered by Todd Shipyards is a fully automatic, forced draft unit, offered in six sizes and seven types to fit all automatically fired boilers or furnaces burning all grades of fuel oils, gaseous fuels, or combination of both. Details and specifications offered.
Page 143 Item 262

PACKAGED ROOF-MOUNT UNITS ....
made by Ventil-Aire save 12% on installation and 7% in construction costs on a 10,000 sq ft building. These packaged air conditioning and heating systems combine all the elements of built-up systems into one compact package. Available in 5, 7½, 10, and 15-ton sizes. Literature and case histories offered.
Page 144 Item 263

MODERN STOKER OFFERED .....
by Bituminous Coal Equipment, Inc. Features factory pre-wired panels, mechanical draft control, fully automatic sequence system, simplicity of operations, true efficiency, and burns coal, the most economical fuel available. Information available.
Page 145 Item 264

MORE HOT WATER .....
can be had, and fast, too, with a Ewing automatic heavy-duty vertical hot water heater. And for less cost because it requires no expensive storage boilers, is simple and easy to install and operate, requires no maintenance, and saves valuable floor space. Information available.
Page 146 Item 265

GAS-FIRED UNIT VENTILATOR .....
from Tuck-Aire Furnace Co. combines economy and comfort with quietest operation. It is AGA approved. Information is available.
Page 147 Item 266

REGISTERS AND GRILLES .....
that bear the Agitair trademark are sure to be quality items. They are available in a wide variety of sizes and styles to meet every requirement of the designer. Made in aluminum, stainless steel, bronze, brass, standard steel, and plated finishes. Catalog offered.
Page 148 Item 267

DUCT TAPES .....
made by Arno will modernize any unsealed duct system, increasing air flow at registers considerably. Tape sticks instantly and holds permanently. Flame-resistant, non-flame resistant types available. Sample offered.
Page 150 Item 268

BURNERS AND CONTROLS .....
are both manufactured by Webster Engineering, division of Midland-Ross Corp. Gas and/or oil burners as well as control centers permit the company to take full responsibility for a complete system. Information available.
Page 151 Item 269

NEW TRIANGLE VALVE .....
by U. S. Valve & Engineering Co. is a combination of two precision-engineered butterfly valves in a flanged T. Gives perfect flow control in cooling water systems where two streams flow to or from a single pipe. Information available.
Page 151 Item 270

LOW COST AIR CLEANER .....
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Inside Back Cover Item 273

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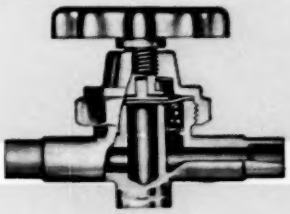

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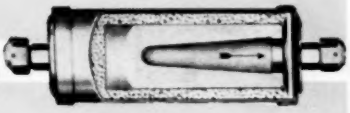

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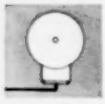
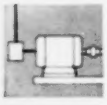


to sound an alarm—when flow stops in a process system or in any water cooled devices.



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